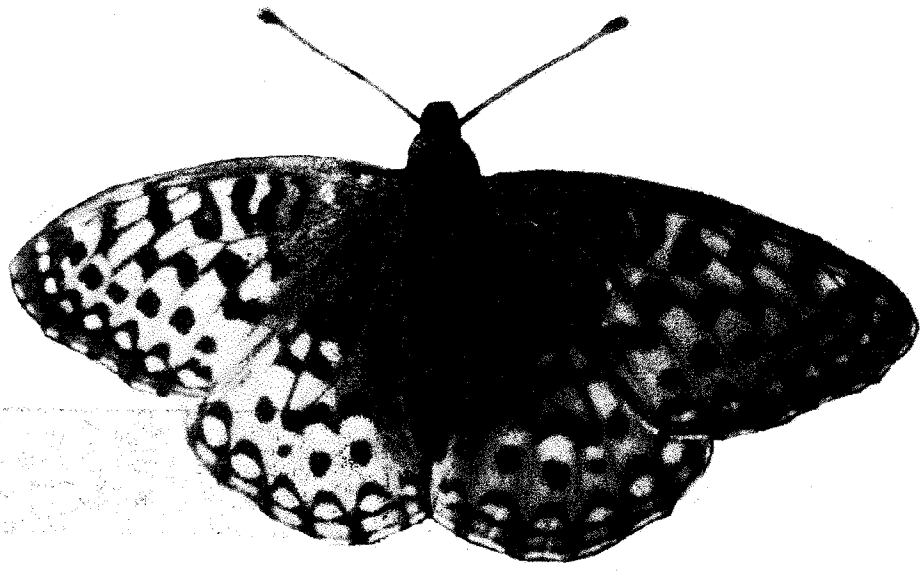
DRAFT

Camp Rilea
Oregon Silverspot Butterfly
Habitat Management Plan



Oregon Army National Guard
1998

DRAFT

Habitat Management Plan

for the

Oregon Silverspot Butterfly
(Speyeria zerene hippolyta)

Camp Rilea
Clatsop County, Oregon

March, 1998

prepared by

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for the

Oregon Military Department

Oregon Army National Guard

EXECUTIVE SUMMARY

Camp Rilea is a 1,850-acre Oregon Army National Guard training area on the Oregon coast that is considered habitat for the Oregon silverspot butterfly. The silverspot is a federally-threatened species, protected under the Endangered Species Act. This act requires federal agencies to ensure that their actions do not jeopardize the continued existence of threatened or endangered species, and to consult with either the U.S. Fish and Wildlife Service or the National Marine Fisheries Service. The silverspot has five population centers on the Pacific coast, one of which is the Clatsop Plains. Some of the most critical habitat on the Clatsop Plains is on Camp Rilea. Therefore, the Oregon Military Department (OMD) has designated 63 acres as official silverspot habitat and has restricted most training from these areas.

The OMD, primarily through Dr. Paul Hammond, has been researching silverspots and developing this management plan since 1989. The experimental program, conducted from 1990-1993, identified the appropriate areas and methods for silverspot habitat protection on the camp. Mowing the 63 acres, monitoring the resulting vegetation, and observing silverspots comprise the bulk of management efforts. Ongoing monitoring has adjusted and refined the management program to that described in this plan. In addition, OMD staff regularly coordinates with the U.S. Fish and Wildlife Service and participates in the efforts of the Oregon Silverspot Butterfly Working Group.

All of the above efforts are being conducted in order to ensure continued military training at Camp Rilea, to avoid jeopardizing the existence of the silverspot butterfly, and to mitigate the OMD's adverse effects on this species from various activities at Camp Rilea. Although we recognize that we cannot sustain a viable population of silverspots for the entire region, providing a portion of the needed habitat on the Clatsop Plains is our main goal. Our specific objectives are to maintain the designated critical habitat areas in fair to good condition and to observe a number of silverspot butterflies using these areas. We will also continue to participate with other agencies in attempting to meet the silverspot needs of the region.

The Oregon silverspot butterfly is distributed along the Pacific coast from Washington to Northern California. Adults are dependent on nectar plants such as goldenrod and aster, while low-growing violets are the only food plant for the larvae. A single generation is produced each year, with egg laying/hatching in the summer/fall and larval emergence in the spring. Meadow ecosystems are the most critical habitat areas due to their importance for feeding and breeding.

A program of three separate annual mowings (twice in the spring and once in the fall) has been shown to maintain a meadow ecosystem and promote the plant species required by the silverspot, at the proper height. Monitoring has shown that undesirable species such as Scotch broom and bent grass have been reduced in number, while goldenrod and violets have increased dramatically, thus substantially improving the habitat. The silverspot butterfly initially increased its numbers in conjunction with these improvements, but then observations began declining after 1992. Varying weather conditions during the monitoring period is thought to have had some impact on silverspot numbers. It is believed that the general decline of silverspots on the Clatsop Plains is limiting the potential success at Camp Rilea. Therefore, genetic augmentation of silverspots at Camp Rilea has been proposed and is being considered.

Continued military training, management activities, and planned construction and maintenance projects should have little adverse impact on the silverspot butterfly or the 63 acres of designated habitat. Most impacts will be temporary, and short-term. These will be offset by the long-term protection of the critical habitat areas and the resulting annual production of silverspots. In fact, it is estimated that without active management of the designated habitat areas, most of these areas would evolve from a meadow ecosystem to shrub land and forest, effectively eliminating the habitat value and the silverspot butterfly. With management, silverspot numbers are projected to increase, although this appears to be dependent on the collective management efforts of all parties on the Clatsop Plains as a whole. In return for a long-term commitment to protect silverspot habitat on Camp Rilea, the OMD will be able to allow military training and other activities outside of the designated habitat areas without violating the Endangered Species Act.

ACKNOWLEDGEMENTS

Many people have assisted with the research and development of this management plan, beginning with the initial planning in 1989.

Diana Hwang has provided coordination for the U. S. Fish and Wildlife Service throughout the term of the project, and David V. McCorkle of Western Oregon University provided much helpful information and advice.

I particularly want to thank Sergeant Major Gerald E. Elliott, Lieutenant Frances A. Smith, and Gregory A. Mitchell of the Oregon Military Department for their planning and supervision of this project, and Chief Warrant Officer Ronald D. Kinsley, who directed the management program at Camp Rilea.

In the past, Lieutenant Colonel Douglas J. West and Major Larry J. Studer provided much assistance during the first years of the project. Captain Geoffrey G. Liljenwall and Captain Donald L. Rolph provided much information and helpful coordination during the field work, and CPT Liljenwall developed the Habitat Management Area maps that are included in this document. I also thank Brigadier General Charles Rosenfeld, Colonel Donald A. Waller, and Command Sergeant Major William Lane for their interest and cooperation with this project.

Finally, I want to acknowledge the field assistance of Staff Sergeant Spencer Hooley of Laramie, Wyoming, who volunteered his free time when his unit trained at Camp Rilea in 1991.

Paul C. Hammond, PhD.

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INTRODUCTION

CAMP RILEA

Camp Rilea is a National Guard training facility owned by the State of Oregon and operated by the Oregon Military Department. It is located on the northern Oregon coast at Warrenton, which is approximately midway between Astoria and Seaside.

Camp Rilea contains approximately 1,850 acres of land, and is situated between US Highway 101 and the Pacific Ocean. It has been in continual operation as a military training camp since 1927, when it was founded and officially known as Camp Clatsop. In 1959, the Camp was renamed Camp Rilea in honor of Major General Thomas E. Rilea, who had been the Adjutant General of Oregon from 1941-1959.

Varying types and amounts of military training have been conducted at Camp Rilea throughout its history. Today, Camp Rilea is the home of both Oregon Army and Air National Guard units. It is a full-service facility that can serve up to 1,500 soldiers at any one time. In fact, Camp Rilea is the only Oregon National Guard facility in the state large enough to house and support a reinforced battalion-sized unit. For this reason, it is an extremely valuable facility for the National Guard.

Training activities at Camp Rilea focus on Infantry and Combat Engineer skills, but facilities are available for a wide range of other training opportunities. Development within the "cantonment" area provides command and control buildings, classrooms, housing, numerous small-arms firing ranges, other support facilities, and the infrastructure to operate the Camp. The remainder of the Camp is unimproved land which is kept available for dismounted maneuver training. During the last few years, an average of 60,000 personnel have trained at Camp Rilea each year from the Oregon National Guard, regular Army units, other reserve units, and state and local police agencies.

The mission of Camp Rilea is twofold:

(a) In supporting federal military training requirements of the Oregon Army and Air National Guard, Camp Rilea is designed and operated as a training site to support various military training activities, provide support facilities for military schooling, and provide training lands for tactical maneuver training.

b) In supporting the National Guard's mission as a state militia and emergency response provider, Camp Rilea is operated and maintained with the express intent of providing on-going support to the state and civilian community.

Upon receipt of orders and authority from a higher headquarters, Camp Rilea has the capability and resources to support a brigade-size element of about 3,000 soldiers. Therefore, the camp could be used as a mobilization site for military operations and could

be activated as an emergency assistance/response center for reacting to state and local emergencies. In fact, Camp Rilea is already used as a storage facility for emergency spill response equipment owned by the US Coast Guard.

THE OREGON SILVERSPOT BUTTERFLY

The Oregon silverspot butterfly (Speyeria zerene hippolyta) is a federally-listed threatened species that occupies coastal grasslands near the Pacific Ocean, from Washington south to Northern California. As discussed by Hammond & McCorkle (1984b), populations of this butterfly have mostly disappeared along the coasts of Washington, Oregon, and California due to a combination of human development and natural ecological succession of grassland meadows to brushland and forest. Today, only five major population centers for the silverspot butterfly still survive. They include:

(1) The Del Norte County population in California north of Crescent City;

(2) The central coast population in Lane County, Oregon on the Siuslaw National Forest;

(3) A population on Mt. Hebo in Tillamook County, Oregon, also on the Siuslaw National Forest;

(4) A population on Cascade Head in Tillamook County; and

(5) A sand dunes population on the Clatsop Plains of Clatsop County, Oregon, and on the Long Beach Peninsula in Pacific County, Washington.

As a consequence of this decline, the Oregon silverspot butterfly was federally listed as a threatened species in 1980 (Stine, 1982).

The Clatsop Plains population is broadly distributed between Seaside and Astoria. Historically, it was first observed near Astoria around 1920, near Sunset Lake in 1952, and near Gearhart in 1973. Much of the original habitat has been lost to housing developments and ecological succession. Today, an estimated 800 acres of habitat still survive. Only about 100 acres are in public ownership, including 75 acres on Camp Rilea and about 25 acres on adjacent Clatsop County land to the south. All of the remaining habitat is located on private lands, and much has become severely degraded due to ecological succession or a lack of management.

HABITAT AREAS ON THE CLATSOP PLAINS AND CAMP RILEA

There are three major habitat areas on the Clatsop Plains, including the Del Rey Beach area north of Gearhart, the Sunset Lake area, and the Camp Rilea area. All of the habitat areas on public land are concentrated in the latter area, while the entire Sunset

Lake and Del Rey Beach areas are privately owned. At present, about 63 acres of habitat are actively managed for the Oregon silverspot butterfly at Camp Rilea, and about 10 acres on private land in the Del Rey Beach and Sunset Lake areas.

The Oregon silverspot butterfly occupies two classes of habitat on Camp Rilea and the Clatsop Plains in general. One category is the broad adult flying zone, and the second is the more specific violet breeding habitat. (Appendix 1 contains definitions of selected terms.) Virtually all of Camp Rilea is within the flying zone of adult butterflies, and is therefore adult habitat with respect to behaviors such as general flying, nectaring on flowers, laying eggs in meadows, and mating in forest fringe areas. There is very little chance of "take" or killing of adult silverspot butterflies in most places on Camp Rilea from normal military training and maintenance activities, with the possible exception of pesticide spraying for mosquitoes. Even vehicular traffic on camp roads poses little threat to adult butterflies because of the slow speeds (posted 25 mph speed limit).

However, the various breeding stages of the silverspot butterfly (eggs, larvae, pupae, and adults) are highly vulnerable to inadvertent killing within the violet breeding habitat from various military training and maintenance activities. Mortality of eggs, larvae, and pupae from crushing would likely result from such activities as mowing, concentrated foot traffic, vehicular traffic, construction projects, and general maintenance activities. In addition, chemicals applied in and near violet breeding habitat could kill silverspot butterflies.

CAMP RILEA HABITAT MANAGEMENT EFFORTS

The Oregon silverspot butterfly was first observed at Camp Rilea by Dr. Paul Hammond and others in the early 1980s (Hammond & McCorkle, 1982). More extensive surveys were subsequently conducted by Hammond & McCorkle (1985) and Hammond (1988a). Beginning in 1989, the Oregon Military Department began identifying and planning for active management of silverspot butterfly habitat on Camp Rilea, in cooperation with the U.S. Fish and Wildlife Service (USFWS). In addition, from then to the present, OMD personnel have participated in Oregon silverspot butterfly Working Group meetings sponsored by the USFWS, and have encouraged continued habitat research by Hammond and McCorkle at Camp Rilea.

In 1989, federal funds were obtained from the National Guard Bureau (NGB) to initiate more intense research on the Clatsop Plains population and to specifically develop a Habitat Management Plan for the silverspot butterfly on Camp Rilea. Four years of research were conducted by Dr. Hammond, as described herein, and the data generated during this effort form the basis and justification for this Habitat Management Plan. Frequent correspondence was exchanged and several meetings were held with USFWS personnel while developing the plan to ensure that provisions of the Endangered Species Act are adequately addressed, and to ensure that the capabilities of Camp Rilea to support its military training and emergency service missions are maintained to the maximum extent practicable.

The first habitat renovation work began in 1990, and a detailed research study was conducted in 1991, 1992, and 1993. This work was further supplemented by additional monitoring data gathered from 1994-1997. The results of the research and management program, which are contained within this plan, will serve as a guide to habitat management at Camp Rilea through the year 2017. Progress with the research program was summarized in annual reports by Hammond (1991-1996).

Based on the above research, ten (10) habitat management areas and three (3) peripheral forest fringe areas have been identified on Camp Rilea property. The habitat areas are proposed for continued management and monitoring under this Habitat Management Plan. Other actions, deemed necessary to improve the habitat or to allow required Camp Rilea support activities to continue, are described in detail and analyzed for potential impacts to the butterfly or habitat areas in the document.

GOALS AND OBJECTIVES

One goal of this plan is to describe how the OMD intends to mitigate the adverse effects of proposed actions at Camp Rilea on the Oregon silverspot butterfly. It is believed that with this plan, jeopardizing the existence of the butterfly will be avoided, thus fulfilling our federal responsibilities under the Endangered Species Act (ESA). (The OMD is acting as the agent of the NGB for this matter.) The ESA requires federal agencies to ensure that their actions do not jeopardize the continued existence of threatened or endangered species, and to consult with either the USFWS or the National Marine Fisheries Service (NMFS) through a process spelled out in Section 7 of the act. Section 7 requires that federal actions be assessed as to their effects on listed species and designated critical habitat, that agencies prepare biological assessments and consult with USFWS or NMFS, and that the USFWS or NMFS provide a biological opinion. This plan forms the basis of our biological assessment.

This plan also shows how Camp Rilea will participate in efforts to conserve the butterfly on the Clatsop Plains. It is the OMD's hope that this plan will expedite cooperation and coordination among agencies, organizations, and persons concerned with the butterfly, and lead to a more comprehensive conservation plan for the entire Clatsop Plains. With only a limited amount of suitable habitat, the OMD cannot recover and ensure the long-term conservation of the butterfly on the Clatsop Plains by itself.

Thus, another goal of this plan is to provide a portion of the necessary habitat for a Clatsop Plains population of the Oregon silverspot butterfly on Camp Rilea, without significantly compromising military training capabilities. This would be accomplished by managing 63.44 acres currently identified as crucial habitat to maintain or achieve fair or better habitat conditions (as defined below). These areas would not be directly used for active military training. The Camp Rilea habitat management areas would comprise about 6-8 percent of the suitable habitat required to sustain a viable population of the butterfly on the Clatsop Plains and thus, should account for approximately 6-8 percent of the butterfly population on the Clatsop Plains. Habitat management areas on Camp Rilea

would be provided for a minimum of 20 years or until habitat conservation efforts elsewhere on the Clatsop Plains make these 63.44 acres unnecessary. This plan will be reviewed every five years and the need to continue this program re-evaluated after 20 years.

The specific objectives of this plan are to:

1) Achieve and maintain a fair or better condition for 90 percent of the habitat management area, extrapolated from linear transects (i.e., 90% of the total of all transect lengths). Fair condition is defined as 0.26-0.50 violets per linear foot.

2) Achieve and maintain a good or better condition for 50 percent of the habitat management area, extrapolated from linear transects (i.e., 90% of the total of all transect lengths). Good condition is defined as 0.51-1.00 violets per linear foot.

3) Observe at least 20 female Oregon silverspot butterflies using the habitat management area during the late summer/fall. This number is about one-third of the estimated population potential of Camp Rilea's habitat management area.

It should be noted that efforts to preserve the Oregon Silvespot Butterfly and its meadow ecosystem will benefit a number of other plants and animals, some of which are unique (see page 10).

LOCATION OF HABITAT MANAGEMENT AREAS

The maps contained in Appendix 2 illustrate the location of concentrated areas of Viola adunca, which have been determined to be important habitat areas for the Oregon silverspot butterfly on Camp Rilea. For management purposes, the violet habitat has been divided into numbered management areas (1-10) and sub-areas (N,S,E,W), as shown.

MAP 1 identifies all habitat and forest fringe areas on Camp Rilea. Five additional maps show each of the habitat management areas on a larger, more detailed scale. Actual management areas, together with the number of acres included in each management area, are described as follows:

MAP 2 shows Area 1.

AREA 1 (9.40 acres) is relatively flat land located on the west side of N. Neacoxie Road just north of the Second Causeway Road. This area is generally surrounded by gently rolling, open land with trees and other large vegetation.

MAP 3 shows Area 2 and Area 3.

AREA 2 (4.96 acres) is generally east-facing sloped land located on the west side of N. Neacoxie Road east of the firing line for the Modified Automated Record Fire (MARF) Range. An accessway, parking area, and support structures are located to the south of this area and support small-arms weapons firing and other training activities on the MARF Range.

AREA 3 (6.81 acres) is modestly east-facing sloped land and encompasses the area around the NBC Chamber, south to the First Causeway Road. Area 3 also includes a small area of habitat on the east side of N. Neacoxie Road bordering Neacoxie Creek.

MAP 4 shows Area 4 (W & E).

AREA 4 (8.12 acres) includes both west-facing and east-facing land on both sides of the existing dune. The area extends north-to-south along the dune from the First Causeway Road south to Demo Road. Area 4 is divided into two areas. Area 4W includes land on the west side of the dune bordering Valley Way Road. Area 4E includes land on the east side of the dune, and extends south through the current position of the Camp Rilea flag pole. In addition to encompassing the flag pole area, Area 4E is bordered on the east by the BOQ/BEQ facility and several other existing buildings.

MAP 5 shows Areas 5 (N & S), 6, 7 (N & S), 8, and 9 (N, S & E).

AREA 5 (4.66 acres) is gently west-sloping land which extends from Demo Road south to Range Road. Area 5 is divided into two areas. Area 5N includes land on the east side of Valley Way Road, and Area 5S is located on the west side of Range Road at its intersection with Valley Way Road. Area 5N borders an existing known-distance rifle range, and Area 5S is situated just north of the existing pistol range.

AREA 6 (4.31 acres) is gently rolling land located between Range Road and Slusher Lake Road, and includes the existing Hand Grenade Range. The rappeling tower is located across Slusher Lake Road at the southeast corner of Area 6.

AREA 7 (6.28 acres) is gently rolling land on the top and west side of the dune, which extends from Range Road south to Slusher Lake Road. It is situated east of Area 6 and west of Area 9. An old spur of Slusher Lake Road, which is still used, divides Area 7N from Area 7S. The top of the dune marks the dividing line between Area 7S and Area 9W to the east.

AREA 8 (.87 acres) is modestly west-facing land located in the southeast corner of the junction of Slusher Lake Road and East Slusher Lake Road.

AREA 9 (2.62 acres) is generally flat to east-facing land located at the south ends of Pacific Road and S. Neacoxie Street. As shown on the map, Area 9 is divided into three sections: Area 9W, Area 9N, and Area 9S. Both Areas 9N and 9S are in close proximity to existing buildings which are currently being used for permanent and/or temporary housing.

MAP 6 shows Area 10.

AREA 10 (15.41 acres) is relatively flat land which extends along the east shore of Sunset Lake south to the southeast corner of Camp Rilea.

A summary of the total acres of violet/silverspot breeding habitat proposed for management at Camp Rilea is outlined as follows:

AREA	ACRES
1	9.40
2	4.96
3	6.81
4W	3.92
4E	4.20
5N	2.82
5S	1.84
6	4.31
7N	4.86
7S	1.42
8	0.87
9W	0.86
9N	0.89
9S	0.87
10	15.41
TOTAL ACRES	63.44

LOCATION OF FOREST FRINGE AREAS

Forest fringe areas which provide habitat for adult Oregon silverspot butterflies are shown on MAP 1. These areas consist of open areas bordering forest edges or within forests of tall, dense conifer trees. Three areas of conifer forest on Camp Rilea have these characteristics. One area is located along the jeep trail just east of CEV Road. A second area is located along GammaGoat Road from the Second Causeway Road south to Demo Road. The third area extends from East Slusher Lake Road to the Chateau.

BIOLOGY AND LIFE HISTORY

OREGON SILVERSPOT BUTTERFLY

The Oregon silverspot butterfly (Speyeria zerene hippolyta) belongs to the genus Speyeria in the family Nymphalidae. This is a large and complex group of butterflies with 13 species and about 112 subspecies. Speyeria zerene is one of these complex polytypic species, consisting of 14 subspecies that belong to five major subspecies groups. Of these, the bremnerii group is distributed in the Pacific Northwest, and includes five subspecies in inland areas from Washington to Oregon and southward along the California coast. The coastal subspecies of this group is Speyeria zerene hippolyta, which once enjoyed a wide distribution along the Washington and Oregon coasts, with a disjunct population near Crescent City in Del Norte County, California. McCorkle & Hammond (1988) have reviewed the taxonomy and relationships within this group of butterflies.

The life history, ecology, and adaptations to the coastal environment of Speyeria zerene hippolyta have also been studied by McCorkle (1980) and McCorkle & Hammond (1988). This insect is a medium-sized butterfly (wing-spread about 2 inches) with orange wings marked with a distinctive pattern of black spots and bars on the dorsal wing surface. On the ventral side of the hindwing, it has bright metallic silver spots that are the basis for the common name.

Adult silverspot butterflies fly during about three months of the year, beginning in early July and continuing until the first of October. Males emerge first in July and August, with females emerging in August and September.

However, the silverspot population on the Clatsop Plains displays some unusual characteristics not found in other silverspot populations. This includes a strong tendency for adult butterflies to migrate from grassland breeding habitat into forest fringe areas, where they spend much of their time in July and August. Female butterflies migrate back to the grasslands in late August and September to lay their eggs. Adults are highly vagile on the Clatsop Plains and appear to fly up to five miles or more during these migrational movements. Based upon observations of individual specimens in the field, the butterflies appear to live for three to eight weeks. Specific details of this biology are discussed by Hammond & McCorkle (1985) and Hammond (1988a).

Thus, females display a photoperiod-dependent reproductive diapause during August that is broken by the shorter day length of late August. Short day length apparently stimulates the corpora allata glands to produce juvenile hormone, which in turn triggers egg production (Chapman, 1969; Sims, 1984).

There appears to be a significant change in flight behavior as the female silverspot ages. Fairly young females are highly vagile in behavior, and appear to disperse widely and swiftly through the length of Camp Rilea. They would typically land briefly in one area, laying a few eggs before flying a long distance to another area to lay a few more

eggs. One female flew all the way from the north end of Area 1 to Area 9 on a single day.

In sharp contrast, the old females were extremely sedentary, and appeared to concentrate their oviposition in a single area. Indeed, two individual females did not move outside of Area 7N during three weeks of observation. Sedentary females appear to choose areas with large concentrations of violets and nectar flowers, and they spend nearly all their time visiting flowers and laying eggs. Young females spend much of their time flying long distances. Presumably, there are reproductive advantages to both types of behavior, both for long-distance dispersal of progeny and for maximum utilization of prime habitat.

On the Clatsop Plains, the sand-dune goldenrod (Solidago spathulata) is by far the primary nectar plant for female silverspots during September. Douglas aster (Aster subspicatus) is also used as a nectar plant to a small degree, but it usually does not start blooming until the last week or two of September at the close of the butterfly flight season. When given a choice between goldenrod and aster, the butterflies clearly prefer goldenrod.

Males of the Oregon silverspot are strongly territorial on the Clatsop Plains and patrol sharply defined mating territories within the forest fringe. They rarely patrol the grassland breeding habitat looking for females, but wait for the virgin females to enter their territories. Mating territories are apparently chosen by the males on the basis of two factors, protection from strong ocean winds and the presence of nectar flowers. All of the mating territories observed by Hammond & McCorkle (1985) and Hammond (1988a) were in sheltered areas along the forest fringe and in small forest openings well protected from the wind. In addition, virtually all mating territories also included nectar flowers. Males spend their time slowly flying back and forth within the confines of the territory looking for females, visiting the flowers, or sitting on sunlit leaves and branches. They never return to the breeding habitat, and individual males were observed to remain at a single site for up to three weeks.

A critical habitat requirement for the silverspot is very low violet breeding habitat, about 3-8 inches high at the time of female oviposition in August and September. Viola adunca, Solidago spathulata, and other low-growing native meadow plants require this condition for good growth as shown by the mowing experiments on Camp Rilea. Moreover, female silverspots conduct most of their oviposition in such low habitat, and strongly avoid tall, overgrown habitat as shown by studies on the Suislaw National Forest (Hammond, 1994a) and by the no-mowing experiments at Camp Rilea (Hammond, 1994b).

After the females return to the meadow breeding habitat for oviposition, the eggs require 3-4 weeks to hatch in the field. The first instar larvae hibernate without feeding through the fall and winter months. When the violet foodplant begins to grow again in April and May of the following year, the larvae again become active and begin feeding on the foodplant. On the Clatsop Plains, the only foodplant is the common blue violet

(Viola adunca). The ecology and habitats of this violet have been described by Hammond & McCorkle (1984a) and Hammond (1988b).

Silverspot larvae grow through six instars, molting to a larger size each time. When fully mature, larvae are about 1.5 inches in length and covered with sharp spines that protect against predators. They are dark blackish brown in color and have a pair of yellow, longitudinal lines down the back. Larvae reach maturity over an extended period from mid-June to mid-August. When fully grown, the larva searches for a pupation site in taller vegetation. It forms a pupation chamber by sticking several leaves together with silk, and turns into a pupa hanging from the top of the chamber. After about two weeks in the pupal stage, the insect finally ecloses into an adult butterfly. Consequently, this species spends most of the year as a larva, and only 2-3 months as an adult. There is only a single generation each year.

VIOLA ADUNCA

The biology and ecological requirements of Viola adunca were studied in considerable detail by the U.S. Forest Service on the Siuslaw National Forest (Hammond & McCorkle, 1984; Hammond, 1987). This plant is a small, low-growing herb. It is normally only 1-2 inches in diameter with the form of a rosette, but some old plants may be considerably larger and reach a size of up to 10-12 inches. In the sand dunes of the Clatsop Plains, the plant grows very close to the ground in low vegetation about 2-3 inches high, but longer stems 3-6 inches high are produced in taller vegetation. The coastal race of Viola adunca is unusual in producing large, deep violet flowers about 1/2 inch or more in diameter. These are produced during the spring, from late April to early June, and there is often additional blooming in September following late summer rains. Because the plants are relatively inconspicuous to human observers, violet counts are best conducted in May when the showy flowers are present.

Reproduction of Viola adunca is limited to seeds produced in small capsules. There are usually about 10-20 seeds per capsule, and each flowering stem produces 3-6 capsules over the growing season. Thus, large plants can produce several hundred seeds per year. The capsules pop open explosively by a spring mechanism when mature, scattering the seeds over a wide area near the parent plant.

Seeds of Viola adunca are quite small, about 1-2 millimeters in length, and are hard, round, and black in color when mature. They are able to remain dormant in the soil seed bank for many years, perhaps for as long as 20-30 years. Each seed has a knob-like structure at its base called an elaiosome that contains nutrients such as oils that are attractive to ants. Consequently, ants may be important for long-distance dispersal of violet seeds through the meadow habitat.

Viola adunca is an early successional plant in open grasslands, and it is easily crowded out by taller grass and woody vegetation. Frequent disturbance from fire, livestock grazing, or mowing is most beneficial for this species. Nevertheless, previous

Forest Service studies discovered that established violet root-stalks are capable of surviving in a dormant, suppressed condition for many years under dense grass and woody shrubs. Once the competing cover is removed, the violets are able to resume their growth. This phenomenon has been quite evident in the renovation management areas at Camp Rilea during 1991-1993.

NECTAR FLOWERS

The primary nectar flower used by the Oregon silverspot butterfly at Camp Rilea is the sand-dune goldenrod (Solidago spathulata). Three other plants are also used, including Douglas aster (Aster subspicatus), false dandelion (Hypochaeris radicata), and pearly-everlasting (Anaphalis margaritacea). The latter is used along forest edges, and is one of the major nectar sources in zones of forest fringe. False dandelion is primarily used early in the season (late July to early August) before significant numbers of goldenrod have come into bloom. Male silverspots were seen using false dandelion several times in Area 1.

Douglas aster is usually of little significance as a nectar flower at Camp Rilea. Most plants do not come into bloom until late September, when the butterfly flight season is nearly finished. Even when asters are available, silverspot butterflies clearly prefer goldenrod when a choice is available. Nevertheless, asters may be very important during some years when goldenrod is not available. For example, during the El Nino drought of 1992, goldenrod flowers had completely disappeared from Camp Rilea by the middle of September, and virtually all nectaring through the remainder of the adult flight season in late September was confined to asters.

Nectaring activities by silverspot butterflies typically take place in mid-morning (1000-1130) and again in late afternoon (1530-1730). Female butterflies spend the middle part of the day engaging in oviposition. This activity pattern was observed through all four weeks of September, except under cool, foggy, or cloudy conditions.

The sand-dune goldenrod forms large, circular, clonal-type colonies up to 10 feet across. Undoubtedly, there is a correlation between the size and age of a colony. Large colonies may easily be 20-50 years old. Since the colonies are clones, all individual plants within the colony bloom at the same time. However, there is a wide genetic range in blooming season among different goldenrod colonies, so some colonies are in bloom almost the entire length of the silverspot flight season.

A fair number of goldenrod colonies are in bloom by the middle of August. However, the peak blooming season takes place during September, which is also the peak period for oviposition in the meadows by silverspot females on the Clatsop Plains. In fact, it is very likely that the Clatsop Plains silverspot population has specifically evolved an oviposition season to match the blooming of goldenrod in the meadow habitat.

Goldenrod plants grow very slowly, and the seedlings appear to take about five years to reach blooming size from seed germination. Seeds planted in cleared areas at Camp Rilea in 1991 were still only small rosettes about 1-3 inches across by 1993, at two years of age.

MEADOW ECOSYSTEM AT CAMP RILEA

Hammond (1988b) has described the native meadow ecosystem on the Clatsop Plains that forms the habitat for Viola adunca and the Oregon silverspot butterfly. It is a very complex community that includes a large biodiversity of other plants and animals. Interactions among organisms within this ecosystem are complex, and a species may be directly or indirectly dependent upon many other species. As examples, silverspot larvae require violets for food, adult silverspot butterflies require various flowers for nectar, violets require bees for cross-pollination, violet seeds are dispersed by ants, and butterfly numbers are affected by predators (McCorkle, 1980). Thus, the Oregon silverspot is an indicator species of an endangered ecosystem, and conservation management of Oregon silverspot habitat has multi-species benefits for numerous plants and animals that co-exist with the silverspot butterfly (Hammond & Wilson, 1992).

Three other butterflies are found in these meadows, including the insular ringlet butterfly (Coenonympha tullia insulanus), coastal woodland skipper (Ochlodes sylvanoides orecoastus), and the purplish copper butterfly (Lycaena helloides). The ringlet butterfly is entirely restricted to the Clatsop Plains in Oregon, but is more widespread in northwestern Washington and adjacent British Columbia. In addition, a black tiger moth (Ctenucha rubroscapus) is largely restricted to coastal grasslands in Oregon. A wide diversity of small solitary bees, wasps, beetles, bugs, and other insects are also found in these meadows. Vertebrate animals use this habitat as well, ranging from small passerine birds, shrews, and rodents to large species such as hawks, coyotes, deer, and elk.

Many plants are uniquely adapted to coastal grasslands and sand dunes. TABLE 1 lists both the native and non-native plants found in grasslands at Camp Rilea. In addition to Viola adunca, two nectar flowers are important for adult silverspot butterflies, including sand-dune goldenrod (Solidago spathulata) and Douglas aster (Aster subspicatus). The most dominant plant in this meadow community is not a grass, but rather the sand-dune sedge (Carex pansa). This sedge superficially looks like a grass, and it remains green throughout the summer, despite the dry condition of the sand dunes in mid to late summer. The introduced sweet vernal grass (Anthoxanthum odoratum) is also a common or dominant species in the meadow community.

In addition to the sedge, goldenrod, and aster, other important plants include the introduced false dandelion (Hypochaeris radicata), western buttercup (Ranunculus occidentalis), coast strawberry (Fragaria chiloensis), seashore lupine (Lupinus littoralis), springbank clover (Trifolium wormskjoldii), and common plantain (Plantago lanceolata). Low, wet sites have red fescue grass (Festuca rubra), salt rush (Juncus lesueurii), and

TABLE 1

LIST OF PLANTS IN GRASSLANDS AT CAMP RILEA

Family	Species	Common Name
Equisetaceae	Equisetum arvense L.	field horsetail
Juncaceae	Juncus lesueurii Boland	salt rush
Cyperaceae	Carex pansa Bailey	sand dune sedge
Gramineae	Festuca rubra L.	red fescue grass
	*Festuca arundinacea Schreb.	tall fescue grass
	*Dactylis glomerata L.	orchard grass
	*Agrostis alba L.	bent grass
	*Anthoxanthum odoratum L.	sweet vernal grass
	*Holcus lanatus L.	velvet grass
	Bromus sitchensis Trin.	Sitka brome grass
Iridaceae	Sisyrinchium angustifolium	blue-eyed grass
Liliaceae	Allium cernuum Roth	nodding onion
	Brodiacea hyacinthina Lindl.	white brodiaea
	Brodiaea coronaria Salisb.	harvest brodiaea
	Fritillaria lanceolata Pursh	leopard lily
Orchidaceae	Habenaria greenei Jeps.	Greene's rein-orchid
	Spiranthes romanzoffiana Cham.	ladies-tresses orchid
Polygonaceae	*Rumex acetosella L.	sheep dock
Caryophyllaceae	Cerastium arvense L.	field chickweed

* denotes introduced non-native plants

TABLE 1 (continued)

Family	Species	Common Name
Ranunculaceae	Ranunculus occidentalis Nutt.	western buttercup
Rosaceae	Rosa nutkana Presl	Nootka rose
	Fragaria chiloensis L.	Coast strawberry
Violaceae	Viola adunca Smith	common blue violet
Leguminosae	Lupinus littoralis Dougl.	seashore lupine
	Trifolium wormskjoldii Lehm.	springbank clover
	*Trifolium repens L.	white clover
	*Trifolium procumbens L.	hop clover
	*Cytisus scoparius L.	Scotch broom
Umbelliferae	Sanicula arctopoides H.&A.	bear's-foot
	*Daucus carota L.	wild carrot
Plumbaginaceae	Armeria maritima Mill.	sea pink
Plantaginaceae	Plantago lanceolata L.	common plantain
Labiatae	Prunella vulgaris L.	heal-all
Orobanchaceae	Orobanche fasciculata Nutt.	clustered broomrape
Compositae	Tanacetum douglasii DC.	dune tansy
	Solidago spathulata DC.	sand-dune goldenrod
	*Hypochaeris radicata L.	false dandelion
	Aster subspicatus Nees	Douglas as[illegible]
	Achillea millefolium L.	yar[illegible]
	Anaphalis margaritacea L.	
	Cirsium edule Nutt.	

*denotes introduced non-native plants.

dune tansy (Tanacetum douglasii). A particular feature of coastal grasslands are vast populations of wild orchids and lilies. The most important of these species at Camp Rilea include Greene's rein-orchid (Habenaria greenei), ladies-tresses orchid (Spiranthes romanzoffiana), and the leopard lily (Fritillaria lanceolata).

Areas that have become badly overgrown with brush, particularly the introduced Scotch broom (Cytisus scoparius), tend to lose much of the native plant community. Instead, tall rank-growing introduced plants grow well with Scotch broom and crowd out the native plants, such as Viola adunca. Typical introduced species that cause these problems include orchard grass (Dactylis glomerata), velvet grass (Holcus lanatus), tall fescue grass (Festucaarundinacea), and wild carrot (Daucus carota). Introduced bent grass (Agrostis alba) also causes serious problems through competition with native vegetation, particularly in heavily disturbed areas.

TABLE 2 shows the distribution of both native and non-native plants in the 10 management areas at Camp Rilea. The total number of species and percent of native species are also listed for each management area. Notice that most areas have 18-22 species of plants, and that 70-80% are native species. However, Area 10 was mostly over-grown with old-growth Scotch broom brush, and only 45% of 11 plant species present are native. It should be noted that the same pattern was observed with the insects. While the silverspot, ringlet, copper, and skipper butterflies were common in the most pristine native grassland, very few were seen in Area 10.

AREA 1

Although Area 1 had been overgrown with a considerable amount of Scotch broom, much of the original meadow community has remained (19 species, 79% native). Violets, goldenrod, and asters are still common, and have increased substantially following three years of mowing management (see EXPERIMENTAL MANAGEMENT Section).

AREA 2

The habitat in this area was highly degraded when mowing management began in 1990. Much of Area 2 was overgrown with old-growth Scotch broom and other dense vegetation, including heavy stands of the introduced velvet grass, orchard grass, and wild carrot. Violets and nectar flowers are presently rather scarce as a result. However, much of the original meadow community is still present (22 species, 68% native). Since mowing began, there has been a large improvement in the growth of violets, sand-dune sedge, leopard lilies, and other native plants.

AREA 3

Meadow habitat in Area 3 is currently in excellent condition. It includes the largest concentrations of Viola adunca found on Camp Rilea, and goldenrod is also very

TABLE 2

DISTRIBUTION OF NON-NATIVE (*) AND NATIVE PLANTS IN HABITAT MANAGEMENT AREAS AT CAMP RILEA (1991)

	MANAGEMENT AREAS									
	1	2	3	4	5	6	7	8	9	10
*Festuca arundinacea										+
*Dactylis glomerata		+								+
*Agrostis alba			+	+	+		+		+	+
*Anthoxanthum odoratum	+	+	+	+	+	+	+	+	+	+
*Holcus lanatus		+								+
*Rumex acetosella	+	+			+					
*Trifolium repens			+		+		+			
*Trifolium procumbens			+	+	+					
*Cytisus scoparius	+	+		+		+	+	+		+
*Daucus carota		+								
*Hypochaeris radicata	+	+	+	+	+	+	+	+	+	+
Equisetum arvense		+						+		
Juncus lesueurii	+	+	+	+	+	+	+	+		+
Carex pansa	+	+	+	+	+	+	+	+	+	+
Festuca rubra	+					+				
Bromus sitchensis		+								
Sisyrinchium angustifolium								+		
Allium cernuum				+						
Brodiaea hyacinthina				+						
Brodiaea coronaria				+						
Fritillaria lanceolata	+	+		+						

TABLE 2 (Continued)

	MANAGEMENT AREAS									
	1	2	3	4	5	6	7	8	9	10
Habenaria greenei			+	+	+	+	+	+		
Spiranthes romanzoffiana			+				+		+	
Cerastium arvense	+	+	+	+	+	+		+		
Ranunculus occidentalis	+	+	+	+	+	+	+	+	+	+
Rosa nutkana	+	+					+	+		
Fragaria chiloensis	+	+	+	+	+	+	+	+		
Viola adunca	+	+	+	+	+	+	+	+	+	+
Lupinus littoralis	+		+	+	+	+	+	+		+
Trifolium wormskjoldii	+		+	+	+	+	+		+	
Sanicula arctopoides					+					
Armeria maritima				+	+		+			
Plantago lanceolata	+	+	+	+	+	+	+	+	+	+
Prunella vulgaris					+		+			
Orobanche fasciculata				+					+	
Tanacetum douglasii	+	+				+		+		
Solidago spathulata	+	+	+	+	+	+	+		+	
Aster subspicatus	+	+	+	+	+	+	+	+	+	
Achillea millefolium		+	+					+		
Anaphalis margaritacea								+		
Cirsium edule							+			
TOTAL NUMBER OF SPECIES	19	22	18	22	21	17	21	19	13	11
(%) PERCENT OF NATIVE SPECIES	79	68	78	82	71	82	76	84	77	45

abundant. The primary management problem is a considerable amount of exotic bent grass. The meadow community includes 18 species (78% native).

AREA 4

Most of Area 4 has excellent meadow habitat, although Scotch broom and European beach grass are currently invading some portions. Heavy stands of bent grass in certain areas also pose a management problem. Area 4 is unique on Camp Rilea and in the entire state of Oregon in having huge populations of the leopard lily (Fritillaria lanceolata), literally thousands of plants that bloom in profusion during late May. In addition, it is the only area on Camp Rilea with other species of the lily family, including nodding onion (Allium cernuum), white brodiaea (Brodiaea hyacinthina), and harvest brodiaea (Brodiaea coronaria). Most of the lilies are concentrated on the west side of the ridge (Area 4W), while the Viola adunca concentrations are located on the east side (Area 4E). The meadow community includes 22 species (82% native).

AREA 5

Meadow habitat in Area 5 is in excellent condition. At present, it is the only known area on Camp Rilea with a unique sand-dune adapted member of the carrot family known as bear's foot (Sanicula arctopoides). The meadow community includes 21 species (71% native). There are good populations of both Viola adunca and the various nectar flowers used by silverspot butterflies.

AREA 6

Much of Area 6 has been overgrown with Scotch broom and other tall vegetation. As a result, violets and nectar flowers have been scarce compared to the previous areas, but numbers have improved dramatically as a consequence of mowing management. Much of the native meadow community is still present (17 species, 82% native).

AREA 7

Most of the meadow habitat in Area 7 is in excellent condition, although some Scotch broom is invading. More disturbed areas near the rifle range also have heavy stands of introduced bent grass. In general, violets and goldenrod are very abundant throughout Area 7. This area is unique on Camp Rilea and in the state of Oregon in having huge populations of wild orchids, with thousands of plants blooming from June to August. These include both Greene's rein-orchid (Habenaria greenei) and the ladies-tresses orchid (Spiranthes romanzoffiana). Moreover, Area 7 is the most heavily used area by silverspots. The meadow community includes 21 species (76% native).

AREA 8

Area 8 has been badly degraded and overgrown with Scotch broom and other tall vegetation, such as velvet grass and orchard grass. As a result, violets and nectar flowers

have been scarce. However, following three years of mowing management, violet numbers increased dramatically by the 1993 field season, and goldenrod numbers were also increasing. Much of the meadow community is still present (19 species, 84% native).

AREA 9

Meadow habitat in Area 9 is in good condition with abundant violets, goldenrod, and asters. The primary management problem is posed by heavy stands of exotic bent grass. The total number of plant species is rather low (13 species, 77% native).

AREA 10

Most of Area 10 has long been degraded and overgrown with old-growth Scotch broom brush and tall stands of velvet grass and orchard grass. Violets are mostly surviving at present in the restricted parts that remained open meadow habitat. Almost no nectar flowers are present. In fact, very few plant species are present, and these are mostly introduced weedy plants (11 species, 45% native). However, the violets and sand-dune sedge have greatly increased following three years of mowing management. Consequently, this area does have good future potential as silverspot habitat with continuing management. At present, the primary concern is the absence of native nectar flowers such as goldenrod and aster.

In summary, Areas 1, 3, 4, 5, 7, and 9 have good quality violet/silverspot habitat at present. Areas 2, 6, 8 , and 10 have poorer quality habitat that is now being renovated from heavy stands of Scotch broom brush. Of these, Areas 2, 6, and 8 still retain much of the original meadow community including both violets and nectar flowers. However, Area 10 has been severely degraded with only restricted areas of violets and virtually no nectar plants.

EXPERIMENTAL HABITAT MANAGEMENT (1990-1993) AND SUBSEQUENT MONITORING

The Oregon silverspot butterfly and Viola adunca occupy native grasslands along the Pacific Ocean from Washington to northern California. These grasslands are maintained by frequent disturbance and experience ecological succession to woody shrubs, trees, and tall exotic grasses in the absence of disturbance. As discussed by Hammond & McCorkle (1984b), the original disturbance was fire before European settlement. American Indians apparently used fire as a management tool for perhaps thousands of years to keep the coastal habitat open for their hunting and fishing activities. Based upon historical photographs, much of the Oregon coast was still open grassland as late as 1930, but most has now been overgrown with woody brush and forest. This is the main reason why the Oregon silverspot butterfly has declined during the past 30-50 years.

Historical photographs of Camp Rilea show that much of the central portion of the camp was open grassland during the 1930-1950 period. Today, about 80 acres of native grassland still exist on Camp Rilea, excluding the cultivated lawns around the buildings. Of this, about 25 acres have been maintained over the years in prime condition through frequent mowings with mechanical equipment during the summer growing season. The remaining 55 acres had not been disturbed for many years and had become seriously degraded due to ecological succession with woody brush and exotic grasses. Scotch broom has been the major brush species involved, while European beach grass, orchard grass, and velvet grass have been the most important exotic species.

Beginning in 1990, a program to renovate the 40 acres of degraded grassland was begun. Old-growth Scotch broom brush was removed using a tractor and roller during the first year. Then, the grassland was mowed once each year (1991, 1992, 1993) during late May.

A different management approach was used for the 25 acres of prime-condition habitat. It is thought that frequent mowing of the habitat through the summer growing season results in major mortality to the late-instar larvae and pupae of the Oregon silverspot, particularly in June, July, and August. In addition, mowing removes the nectar flowers used by adult butterflies in August and September. Thus, mowing was largely restricted to October and November in the fall, and April and May in the spring, with a few mowings extending into the first week of June.

An experimental program was conducted within these 25 acres during 1991, 1992, and 1993 to assess the optimum frequency of mowing treatments with regard to the response of: (1) Scotch broom; (2) meadow vegetation; (3) nectar flowers; (4) violets; and (5) silverspot butterflies. The treatment protocol for each management area of prime habitat during these years is summarized in TABLE 3. Management within the areas of degraded meadow habitat for 1991-1993 is summarized in TABLE 4.

TABLE 3

MANAGEMENT OF PRIME MEADOW HABITAT 1991-1993

Area	Treatment 1991	Treatment 1992	Treatment 1993
3	mow late May	no mow	mow late May
4E	mow late May	mow late May	no mow
5N	mow late May	no mow	no mow
5S	mow late May	mow late May	mow late May
7N	no mow	mow late April	mow April and late May
7S	no mow	mow late May	mow April
9W	no mow	mow late May	mow late May
9N	mow late May	mow late May	mow late May
9S	mow late May	mow late May	mow late May

TABLE 4

MANAGEMENT OF DEGRADED MEADOW HABITAT 1991-1993

Area	Treatment 1991	Treatment 1992	Treatment 1993
1	mow late May	mow late May	mow late May
2	mow late May	mow late May	mow late May
4W	no mow	mow late May	no mow
6	mow late May	mow late May	mow late May
8	mow late May	mow late May	mow late May
10	mow late May	mow late May	mow late May

This management scheme was based upon about 10 years of previous experience by the U.S. Forest Service in conducting management of Oregon silverspot habitat along the central Oregon coast on the Siuslaw National Forest (Hammond 1987, 1993). However, it should be noted that the habitat and plant species are very different between the central coast and the Clatsop Plains. Soils are mostly clay or rocky on the central coast, and are sand on the Clatsop Plains. Brush species and other plants are also quite different: for example, salal on the central coast and Scotch broom on the Clatsop Plains. Moreover, the behavior of adult Oregon silverspot butterflies is very different between the central coast and the Clatsop Plains. Thus, it was important to conduct an experimental program at Camp Rilea to assess the effects of various management techniques on the Clatsop Plains. The results of this research specifically apply to the Oregon silverspot habitat at Camp Rilea, but are generally applicable to all of the habitat on the Clatsop Plains between Seaside and Astoria.

The experimental results were complicated by variable weather conditions during the three years of study. In "normal" years, heavy rainfall usually takes place on the Clatsop Plains during the spring months, with a few days of rainfall commonly in late August and September as well. However, July and most of August are usually dry months. Such a "normal" year was seen in 1991. However, the 1992 season experienced an El Nino drought, with very little rainfall and extra warm temperatures. Vegetation began to grow a month early in the spring, and began to mature or dry out a month early in summer and fall. But 1993 was the exact reverse, with cool temperatures and considerable rainfall persisting throughout the spring and summer. These weather variations had considerable effect upon the silverspot butterflies and meadow vegetation, including their response to the experimental management.

Following the completion of the experimental program, all management areas were mowed twice during the spring of 1994. Since then ongoing management has provided new information which has identified additional problems and techniques. For example, the lack of a second spring mowing in 1995 and 1996 has shown the benefit of this practice, as measured by vegetation response. Thus, the need for a second spring mowing in order to meet the management objectives has been confirmed. Specific details of the 1994-1997 management results are presented in the following sections.

RESPONSE OF SCOTCH BROOM

Control of Scotch broom brush (Cytisus scoparius) that is invading the meadow habitat at Camp Rilea involves three different stages in the life cycle of this species:

(1) Germinating seedlings;

(2) Healthy, vigorous bushes;

(3) Old-growth senile bushes.

The latter proved to be quite easy to remove and control. They were simply cut down and smashed with a roller carried by a tractor. In all of the degraded habitat areas cleared of old-growth brush, there was almost no regeneration from the roots.

However, many years of growth had deposited a huge dormant seed reserve in the soil of the degraded habitat areas. Thousands of seedlings were observed germinating the two years following brush removal. Mowing during May was conducted in an attempt to control these new seedlings, although with some mixed success. Seedlings did not survive very well during the 1992 El Nino drought, but considerable numbers of seedlings were observed persisting during the fall of 1993 following the rainy spring and summer. Continued yearly mowing should keep these seedlings under some control, but their ultimate fate will require additional monitoring in future years.

A second Scotch broom problem concerns the eradication of healthy, vigorous plants growing in the prime meadow habitat areas. These broom plants have been mowed off close to the ground each year for 5 to 10 years. As a consequence, the plants have assumed a complicated bonsai-type of growth form consisting of many short trunks at the soil surface. From these trunks, the plants immediately regenerate tall stems soon after mowing.

Two experiments were conducted in 1992-1993 in an attempt to kill these vigorous broom plants. One approach was to mow the bushes in July during the green seedpod stage of development, when food reserves would be depleted in the roots. However, it was discovered that the plants did not begin to bloom much for two years following the cessation of mowing, and that they grew into large bushes 4-6 feet high during this time. Such large plants have a very destructive effect on the habitat, and are too big to be mowed with regular equipment. Consequently, this approach was a failure.

A second approach was to cut bushes off at the trunk base during October of 1992. The herbicide Roundup (glyphosate) was then applied to the cut bases from a small 24 oz. spray can. In this way, the herbicide was tightly confined to just the trunk bases and did not spread to any surrounding vegetation. A 30-foot patch of Scotch broom was treated in this manner, and nearly all treated bushes were dead by the spring of 1993 within the treated area.

RESPONSE OF MEADOW VEGETATION

When research was begun on the native meadow habitat, both at Camp Rilea and on the Siuslaw National Forest, nothing was known about the effects of exotic grass species on native meadow plants, including Viola adunca and nectar flowers. With 10 years of study now completed on both the Clatsop Plains and Siuslaw National Forest, including 7 years at Camp Rilea, we now have a much better understanding of the relationship between native species and exotic grasses (see Hammond, 1993).

Native vegetation is usually about 1-7 inches in height by the end of summer, depending upon the topography and coastal exposure. Along the central coast on the Siuslaw NF, the native meadow grass is a coastal variety of Idaho fescue (Festuca idahoensis). This grass was previously thought by mistake to be red fescue (Festuca rubra). It is a short-growing bunchgrass about 1 inch in height on exposed sites, and about 5-7 inches on more sheltered sites. Flowering stems are about 6-12 inches. In the sand dunes of the Clatsop Plains, the primary native "grass" is sand-dune sedge (Carex pansa), and it grows the same height as the coastal Idaho fescue. This low-lying grass cover is compatible with low-growing herbs including Viola adunca, coast strawberry, wild orchids, seashore lupine, springbank clover, sand-dune goldenrod, leathery grape fern, seaside fleabane (Erigeron glaucus), and bear's-foot (Sanicula arctopoides).

In dramatic contrast to the 1-7 inch height of native meadow vegetation, exotic grasses typically reach 11-28 inches by the end of summer, and these are the low-growing exotic grasses such as sweet vernal grass (Anthoxanthum odoratum) and bent grass (Agrostis alba). Tall exotic grasses such as velvet grass (Holcus lanatus), orchard grass (Dactylis glomerata), and European beach grass (Ammophila arenaria) may reach 40-50 inches by the end of summer. These exotic grasses are completely incompatible with low-growing native herbs such as violets and nectar flowers, and crowd the latter out of existence.

The response of general meadow vegetation, particularly the sedges and grasses, to the various management treatments was monitored in each habitat area at Camp Rilea during 1991-1993. TABLE 3 summarizes management in prime meadow habitat, while TABLE 4 summarizes the degraded meadow habitat. These experiments were designed to assess the response of meadow vegetation to various frequencies and timings of mowing. For the prime habitat areas shown in TABLE 3, the experiments compared consecutive years of mowing, alternate years of mowing and no mowing, and consecutive years of no mowing.

A major complication entered into these experiments due to the variable weather conditions during 1991-1993. The first year had probably the most "normal" weather, 1992 experienced an El Nino drought, and 1993 was cool and rainy during most of the summer.

TABLE 5 summarizes the height of various plant species at the end of summer for the 1991 "normal" year. Note that all areas received a late May to early June mowing, except for Areas 7 and 9W which were not mowed in 1991. These results serve to illustrate the probable "normal" response of meadow vegetation to either mowing or no mowing in a "normal" year.

TABLE 6 summarizes the height of sedge-grass vegetation in late summer for 1991-1993 following either mowing or no mowing treatments during the spring. For the mowed areas, vegetation was somewhat shorter in the 1992 drought year, and was much taller in the 1993 wet year, particularly in Area 9. These results were expected.

TABLE 5

HEIGHT OF VEGETATION
CAMP RILEA MANAGEMENT AREAS
SEPTEMBER 11, 1991

Area	Vegetation	Inches
1	sedges-grass (upland)	3-4
	sedges-grass (lowland)	5-7
	asters-goldenrod	4-6
	tansy	7-12
	rushes	12-25
2	grass (upland)	4-6
	grass (lowland)	7-10
	tansy	7-12
	rushes	9-26
	wild carrot	18-48
3	sedges-grass	4-5
	goldenrod	5-8
4	sedges-grass	4-8
5	sedges-grass	3-5
6	sedges-grass (upland)	3-4
	sedges-grass (lowland)	5-8
	tansy	6-10
7	sedges-grass	4-8
	sweet vernal grass stems	14-24
	bent grass stems	14-22
8	sedges-grass	4-10
	tansy	8-14
	rushes	12-20
9 West	sedges-grass	4-8
	bentgrass stems	14-25
	sweet vernal grass stems	14-25
9 North	mowed sedges-grass	3-4
	unmowed sedges-grass	3-7
9 South	mowed sedges-grass	3-5
	unmowed sedges-grass	5-8
10	grasses	5-9
	rushes	12-21

TABLE 6

HEIGHT OF SEDGE-GRASS VEGETATION (IN INCHES) RESPONDING TO VARIOUS MOWING TREATMENTS DURING LATE SUMMER OF 1991-1993

Area	1991	1992	1993
1	Mowed; 3-7	Mowed; 4-6	Mowed; 5-10
2	Mowed; 4-10	Mowed; 4-6	Mowed; 4-13
3	Mowed; 4-5	None; 14-23	Mowed; 4-10
4	Mowed; 4-8	Mowed; 4-7	None;12-28
5	Mowed; 3-5	None; 11-20	None; 8-25
6	Mowed; 3-8	Mowed; 3-10	Mowed; 3-12
7	None; 4-24	Early mow; 11-19	Mowed; 4-10
8	Mowed; 4-10	Mowed; 3-7	Mowed; 8-15
9	Mowed; 3-5	Mowed; 3-7	Mowed; 5-23
10	Mowed; 5-9	Mowed; 3-5	Mowed; 5-23

For the non-mowed areas, conditions remained quite favorable in Areas 5 and 7 for violets, nectar flowers, and silverspot butterflies during the years with no mowing. However, drastically different results were observed in Areas 3, 4, and 9 during years with no mowing or heavy summer rainfall. These last three areas have heavy populations of bent grass (Agrostis alba) that produces a thick, dense stand of vegetation and much dead thatch. This heavy grass covers and crowds out the violets, nectar flowers, and most other species of meadow plants. Thus, when these areas were allowed to grow up with tall bent grass, the violets and goldenrod were severely repressed, and very few silverspot butterflies used the areas. Thus, for these three areas, yearly mowings certainly appear to be necessary in order to maintain the native meadow vegetation and silverspot habitat. For Area 9, the heavy summer rainfall in 1993 stimulated the bent grass into heavy mid-summer regrowth, in spite of the earlier May mowing (TABLE 6).

In contrast to bent grass problems in the above areas, conditions were much better in Areas 5 and 7, even though the sedge-grass vegetation was nearly as tall in these areas in late summer. However, the dominant grass in Areas 5 and 7 is sweet vernal grass, which produces relatively sparse, open stands in comparison to the bent grass. As a consequence, both violets and goldenrod did relatively well in these areas during 1992,

and Area 7 still attracted the largest number of silverspot butterflies for nectaring and oviposition.

For the renovation Areas 1, 2, 6, 8, and 10, the yearly mowings in 1991-1993 have greatly improved the meadow habitat, as reflected in the increases of violets and goldenrod discussed in the following sections. Other native meadow plants such as sand-dune sedge have greatly increased in these areas as a consequence of the mowing.

Thus, the management objective in this plan for meadow vegetation is to achieve a maximum sedge-grass height of 10 inches in late summer. In 1995 and 1996 some management areas did not receive a second spring mowing in late May-early June due to extended rainy weather. The response of vegetation (maximum height of sedge-grass vegetation in inches in September) is shown below:

Area	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1995	7	7	15	10	8	10	8	18*	9	9
1996	22*	25*	6	5	15*	10*	8	8	8	25*
1997	10	10	10	10	10*	9	9	10	10	10*

*mowed only once the previous spring

As the data show, the 10 inch objective was not achieved in most areas without the second late spring mowing, and Areas 1, 2, and 10 were especially overgrown with tall exotic grasses in 1996 (Hammond, 1996). With two spring mowings in 1997, this problem did not occur.

RESPONSE OF NECTAR FLOWERS

TABLE 7 shows the number of blooming goldenrod colonies (Solidago spathulata) in Camp Rilea management areas during September, 1991-1997. This is the time when adult female silverspot butterflies are present in the meadow habitat. The mowing program for renovation Areas 1, 2, and 6 resulted in substantial increases in blooming goldenrod between 1991 and 1994. There is little or no goldenrod currently present in Areas 8 and 10.

For the prime habitat areas, relatively little goldenrod bloomed in September during the El Nino drought year 1992. This was partly due to the dry conditions at that time, and partly due to the fact that much of the goldenrod bloomed in August, a full month early. As a consequence, silverspot butterflies were mainly dependent upon asters for a nectar source during the last half of September 1992.

However, comparing 1991 and 1994, there has been a tremendous increase in the amount of blooming goldenrod in all of the prime habitat areas (3, 4, 5, 7, and 9). This

TABLE 7

NUMBER OF BLOOMING GOLDENROD COLONIES (Solidago spathulata) IN CAMP RILEA MANAGEMENT AREAS SEPTEMBER, 1991-1997

Area	1991	1992	1993	1994	1995	1996	1997
1	4	11	20	83	84	319	203
2	0	0	3	13	10	14	3
3	46	19	26	156	292	333	980
4	28	4	94	53	264	72	245
5	35	13	60	80	125	83	28
6	4	2	23	15	28	17	2
7	61	19	134	172	298	158	224
8	0	0	2	1	0	0	0
9	20	4	27	92	75	128	143
10	0	0	0	0	0	0	0

appears to be the result of no summer mowing during these years. Before the start of the present management program, mid-summer mowing greatly suppressed the goldenrod and kept it from blooming in September.

We also found substantial adverse effects upon the goldenrod by not mowing during the spring in areas with heavy bent grass stands (Areas 3, 4, and 9). Area 3 was not mowed in 1992. A large drop in blooming goldenrod occurred in September, due in part to the El Nino drought. However, the goldenrod was also severely overgrown with bent grass at the same time. In 1993, a spring mowing took place, but continued summer rainfall allowed the bent grass to grow all summer long, again over-growing the goldenrod in September. In 1994, two spring mowings took place to suppress the grass, the first in early May and the second a month later in early June. This resulted in a tremendous increase in blooming goldenrod for September of 1994.

Similar results took place in Area 4, which was not mowed during the rainy year of 1993. Although considerable goldenrod managed to bloom in September, it was badly overgrown with bent grass. Blooming goldenrod dropped nearly in half the following year of 1994, apparently due to the grass suppression from the previous year.

Area 9 also has abundant bent grass. It has been mowed each spring from 1991-1994. Nevertheless, during the rainy year of 1993, the bent grass grew all summer long, and badly overgrew the goldenrod by September. By contrast, two spring mowings were conducted in 1994, again in May and June, with a tremendous increase in the amount of blooming goldenrod for September. Mowing management continued to increase goldenrod abundance in most areas during 1995-1996.

In 1997, the response of blooming goldenrod patches was extremely variable in different management areas. Very high numbers bloomed in Areas 3 and 4, while goldenrod was quite suppressed in Areas 2, 5, and 6 throughout the season and early in the season within Areas 1 and 7. This suppression appeared to be the result of mid-summer drought. The plants did not grow at all in these areas during June, July, and August. Early September rainfall finally allowed delayed growth and blooming in Area 7 late that month. These results show that other environmental factors affect goldenrod blooming in addition to mowing management practices.

The conclusions that we have reached from four years of experimental management with respect to the goldenrod are that mid-summer mowings suppress goldenrod from blooming, but one or two spring mowings greatly encourage blooming goldenrod in September. Two spring mowings appear to be very important for suppressing bent grass in those areas where this grass is dominant, particularly during rainy years.

RESPONSE OF VIOLETS

TABLE 8 shows the response of violets to the management program in the renovation areas (Areas 1, 2, 6, 8, and 10) for the 1991-1997 years. Areas 1 and 6 are relatively free of exotic grasses. However, Areas 2, 8, and 10 have heavy stands of exotic bent grass, velvet grass, and orchard grass.

In general, there have been dramatic increases in the numbers of blooming violets in all renovation management areas, particularly for Areas 1 and 6. However, the rainy year of 1993 allowed the exotic grasses to grow all summer long in Areas 2, 8, and 10, and the grass had completely over-grown and suppressed the violets by September, 1993. Without exception, there were substantial decreases in the numbers of blooming violets along all transects for Areas 2, 8, and 10 the following spring of 1994.

TABLE 9 shows the response of violets to the experimental management program in the prime habitat areas (Areas 3, 4, 5, 7, and 9) for 1991-1997. Areas 5 and 7 are relatively free of bent grass, while Areas 3, 4, and 9 have heavy stands of bent grass. Numbers of blooming violets dropped sharply in all areas during the spring of 1992, due in large measure to the dry conditions during that year's El Nino drought.

Violet numbers recovered substantially during the rainy 1993 season in Area 7, which is relatively free of bent grass. However, Area 3 was not mowed at all in 1992,

TABLE 8

NUMBER OF BLOOMING VIOLETS ALONG TRANSECTS IN CAMP RILEA HABITAT RENOVATION AREAS, 1991-1997

Transect	Length (ft.)	1991	1992	1993	1994	1995	1996	1997
1-1	112	22	43	84	159	198	88	164
1-2	66	14	23	60	79	56	50	51
1-3	212	6	42	64	74	130	50	69
1-4	121	44	84	59	73	112	154	31
2-1	280	21	17	33	16	22	26	40
2-2	330	15	20	78	11	14	25	41
2-3	135	2	0	0	0	0	0	0
6-1	330	55	88	145	183	50	34	93
8-1	270	31	52	87	51	119	102	48
10-1	40	--	12	23	13	11	14	11
10-2	100	--	32	56	32	68	29	68
10-3	100	--	85	55	28	220	117	124

TABLE 9

NUMBER OF BLOOMING VIOLETS ALONG TRANSECTS IN CAMP RILEA PRIME HABITAT AREAS, 1991-1997

Transect	Length (ft.)	1991	1992	1993	1994	1995	1996	1997
3-1	300	625	120	100	149	225	289	373
3-2	405	793	208	113	132	258	204	412
4-1	450	175	91	32	9	7	18	48
4-2	330	165	85	158	48	138	63	105
5-1	170	115	30	36	94	91	68	103
7-1	330	237	38	194	216	71	27	61
7-2	300	526	269	303	337	414	120	138
9-1	195	260	225	140	205	316	47	9

and the bent grass completely over-grew the violets by the end of 1992, and also during the rainy spring of 1993. This resulted in a continued drop in violet numbers for 1993.

Even more dramatic results were seen in Area 4, which was not mowed during rainy 1993. Along Transect 4-1, violet numbers continued to drop off substantially in 1993, while there was a resurgence to nearly 1991 numbers along Transect 4-2. By the end of the year, however, tall bent grass had completely overgrown Area 4. Thus, by the spring of 1994, blooming violets had almost completely disappeared along Transect 4-1, and had dropped to their lowest level along Transect 4-2. With a return to more normal weather conditions in 1994 and a regular mowing schedule, violet numbers improved in all areas except Area 4, and numbers increased along Transect 4-2 in 1995 in response to the 1994 mowings. However, several years of regular mowing took place before numbers began to increase along Transect 4-1 in 1996 and 1997.

Area 9 was mowed every year. However, it also has heavy stands of bent grass, and the grass strongly over-grew the violets during rainy 1993, resulting in a substantial drop in numbers of blooming violets for that year.

Area 5 has relatively little bent grass. However, it was not mowed in either 1992 or 1993, and violet numbers in 1993 did not recover much from that of the 1992 drought.

As shown in Table 9, the highest violet numbers occurred in 1991 due to continuous mowings throughout the summer as part of routine lawn maintenance. These summer mowings were discontinued after 1990 in order to prevent the potential destruction of developing silverspot larvae and pupae. Consequently, the reduction in violet numbers along the prime habitat transects from 1992 to 1997 is partly the result of a compromise between the need to maximize violet growth and the need to protect silverspot larvae and pupae during the summer growing season.

In conclusion, the experiments with no mowing clearly show that violets disappear in the absence of mowing, particularly in areas with heavy stands of exotic bent grass such as Areas 3 and 4. In order to maintain healthy populations of violets, regular mowing is definitely required every year. This should include one fall mowing in mid-October through December to remove the previous year's growth of vegetation, and in most years, two spring mowings from early April to mid-June, depending upon the weather. This is particularly important in the bent grass areas. Moreover, the mowings should be about 3-4 inches in height in order to encourage low-growing native plants such as violets and goldenrod, while repressing tall-growing exotic grasses. With this mowing practice, the meadow vegetation re-grows to about 5-7 inches in height by late June and July, providing adequate cover for late-instar silverspot larvae and pupae.

During 1995-1996 a second spring mowing was not done in Areas 1, 2, 5, 6, 8, and 10 due to extended rainy weather, and many areas were badly overgrown with tall exotic grasses, particularly Areas 1, 2, 8, and 10. As a result, violets appeared to be suppressed in these areas during 1996 and 1997. Also at this time both violets and goldenrod were severely suppressed along Transect 9-1, possibly due to a combination of drought and dense bentgrass growth.

Until 1994, Area 7 was routinely fertilized as part of lawn maintenance. The use of fertilizer was stopped because of concern about possible toxic effects upon silverspot larvae.

However, numbers of blooming violets dropped off dramatically in this area during 1996 and 1997 without the use of fertilizer. Habitat quality in this area went from good/excellent in 1991 to poor/fair in 1997 (see Table 10). Vegetation in general was quite stunted, probably due to low nitrogen levels in the sandy soil. Experimental applications of nitrogen fertilizer will begin in Area 7 to see if violet growth can be improved in this traditionally high-violet area. If the experiments show that lack of nitrogen is the problem, native clover would be seeded into this area, and possibly other areas.

TABLE 10 compares violet habitat quality along the Camp Rilea transects for 1991, 1993, and 1997 (see Violet Monitoring section for definitions of habitat quality). This substantiates the decline in habitat quality within the prime areas and the improvement in renovation areas. Excluding from consideration Areas 4W and 10, about 24 acres were in fair to excellent condition and 13 acres were in poor to very poor condition at the end of 1991. By contrast, 29 acres were in fair to excellent condition and 8 acres were in poor to very poor condition at the end of 1993. By 1997, 26 acres were in fair to excellent condition and 11 acres were in poor to very poor condition.

However, the 21 acres in Areas 2 and 10 will clearly require a longer period of renovation before reaching prime condition. Area 10 is a special case. Very few violets were visible in 1991, just one year after the old-growth Scotch broom was cleared away. Although the violet transect areas had attained good quality in violet numbers by the end of 1993, they comprise only about 6 acres out of the total 17 acres within Area 10. Few or no violets are found in the remainder of this area. Moreover, the violet areas currently have very few nectar flowers to attract adult silverspot butterflies. Thus, Area 10 will require additional work in future years, possibly including transplantation of nectar flowers such as goldenrod.

RESPONSE OF SILVERSPOT BUTTERFLIES

TABLE 11 compares the numbers of female Oregon silverspot butterflies on Camp Rilea for each week in late August and September of 1991 to 1997. In general, a sharp drop in silverspot numbers was seen in 1992 and 1993, attributed to the El Nino drought of 1992 and the cold, rainy summer of 1993. Thus, a maximum number of 15 butterflies per day was seen in 1991, 7 butterflies per day in 1992, and only 4 butterflies in 1993 and 1994. One interesting feature is that butterflies were flying over a more extended 6 week period in 1992 and 1993, compared to a concentrated 4 week period in 1991 and 1994. Total population size for all silverspot butterflies in the Camp Rilea area is estimated at 40-60 individuals in 1991, 20-40 individuals in 1992, and 15-30 individuals in 1993 and 1994.

The above population estimates are imprecise, and are generally derived by doubling the maximum number of ovipositing females seen per day (TABLE 11) to account for all females over the entire flight season, and doubling this number again to account for males. The range around this number is a best guess.

TABLE 12 compares the habitat use by silverspot butterflies (nectaring and oviposition) in the 10 management areas at Camp Rilea for 1991 to 1997. Of the prime habitat areas,

TABLE 10

COMPARISON OF VIOLET HABITAT QUALITY ALONG CAMP RILEA TRANSECTS FOR 1991, 1993, AND 1997

Transect	1991 Violets/ft.	1991 Quality	1993 Violets/ft.	1993 Quality	1997 Violets/ft	1997 Quality
1-1	.20	poor	.75	Good	1.46	Excellent
1-2	.21	poor	.91	Good	.77	Good
1-3	.03	very poor	.30	Fair	.33	Fair
1-4	.36	fair	.49	Fair	.75	Good
2-1	.08	very poor	.12	Poor	.14	Poor
2-2	.05	very poor	.24	Poor	.12	Poor
2-3	.02	very poor	.00	Very poor	.00	very poor
3-1	2.08	excellent	.33	Fair	1.24	Excellent
3-2	1.96	excellent	.28	Fair	1.02	Excellent
4-1	.39	fair	.07	Very poor	.11	Poor
4-2	.50	good	.48	Fair	.32	Fair
5-1	.68	good	.21	Poor	.61	Good
6-1	.17	poor	.44	Fair	.28	Fair
7-1	.72	good	.59	Good	.18	Poor
7-2	1.75	excellent	1.01	Excellent	.46	fair
8-1	.12	poor	.32	Fair	.18	poor
9-1	1.33	excellent	.72	Good	.05	very poor
10-1	--	--	.57	Good	.27	fair
10-2	--	--	.56	Good	.68	good
10-3	--	--	.55	Good	1.24	excellent

TABLE 11

MAXIMUM NUMBER OF FEMALE SILVERSPOT BUTTERFLIES PER DAY FOR EACH WEEK AT CAMP RILEA DURING LATE AUGUST AND SEPTEMBER, 1991-1997

	1991	1992	1993	1994	1995	1996	1997
Week 1	0	2	2	0	0	0	0
Week 2	4	3	3	3	1	0	0
Week 3	15	7	2	1	3	0	0
Week 4	9	4	4	4	2	0	0
Week 5	6	5	2	3	0	0	0
Week 6	0	2	1	0	0	0	0

TABLE 12

NUMBER OF FEMALE SILVERSPOT BUTTERFLIES OBSERVED IN EACH MANAGEMENT AREA AT CAMP RILEA DURING LATE AUGUST AND SEPTEMBER, 1991-1997

Area	1991	1992	1993	1994	1995	1996	1997
1	0	6	8	5	2	0	0
2	0	0	0	0	0	0	0
3	11	2	2	1	0	0	0
4	6	4	0	0	0	0	0
5	5	2	0	1	1	0	0
6	1	0	1	1	0	0	0
7	55	16	7	9	3	0	0
8	0	0	0	0	0	0	0
9	4	6	2	2	1	0	0
10	0	0	0	0	1	0	0
Yearly Total	82	36	20	19	8	0	0

Area 7 is consistently the most favored area, followed by Areas 3, 4, 5, and 9. However, Area 3 was not mowed in 1992, Area 4 was not mowed in 1993, and Area 5 was not mowed in either 1992 or 1993. A sharp drop in butterfly use of the areas was evident at these times, and is related to the increase in tall, dense stands of bent grass (Agrostis alba). The bent grass often covered up both the violets and nectar flowers during the adult flight season. Major growth in Scotch broom brush also took place in all areas with the cessation of mowing.

Within the renovation habitat areas (Areas 1, 2, 6, 8, and 10), butterfly use continued to be minimal, with the exception of Area 1. During 1993, as many butterflies used Area 1 as Area 7. This may be attributed to dramatic increases in both violets and nectar flowers within Area 1 during 1992 and 1993. Areas 2, 6, and 8 also continued to show steady increases in both violets and nectar flowers during these years, and should become more attractive to the butterflies in future years. Violets have greatly increased in the south half of Area 10, but nectar flowers were still mostly absent from this area at the end of 1993 and 1994.

Therefore, it is concluded that adult silverspot butterflies prefer habitat areas with strong populations of violets and goldenrod. Conditions that favor the plants also favor the butterflies. In particular, areas that were heavily overgrown with bent grass due to the absence of mowing were not used much by butterflies. Regular mowing is clearly required to maintain high quality habitat for violets, goldenrod and butterflies. When bent grass is mostly absent, as in Area 7, conditions remain relatively favorable for one or two years in the absence of mowing, but the bent grass areas require mowing every year as seen in Areas 3, 4, and 9.

Exactly the same observations and conclusions have recently been duplicated for the Oregon silverspot population at Rock Creek-Big Creek on the Siuslaw National Forest (Hammond, 1997). This population had sharply declined to only about 100 butterflies in the 1992-1994 period due to the habitat becoming overgrown with tall, non-native grasses, such as bent grass. In 1994, the U.S. Forest Service adopted Camp Rilea's practice of two spring mowings each year to control the non-native grass problem. In response, the silverspot population increased in 1995 to about 400 individuals. Although numbers lowered to 200 in 1996, a tremendous population explosion occurred in 1997, when over 600 silverspots were observed, the highest number ever for this site in the last 30 years (Hammond, 1997). Thus, Camp Rilea's mowing management program has proven to be quite successful when applied to silverspot habitat on the central Oregon coast.

DECLINE OF THE CLATSOP PLAINS SILVERSPOT POPULATION SINCE 1994

It is evident from Tables 11 and 12 that silverspot numbers have been declining each year since the peak in 1991. As noted above, poor weather conditions in 1992 and 1993 may have been a factor for declines during those years, but 1994 and 1995 were similar to 1991 with favorable weather conditions. This continuing decline at Camp Rilea probably reflects the decline of the overall Clatsop Plains population over these years. It is believed that most successful breeding on the Clatsop Plains has been limited to Camp Rilea since 1991. It is also obvious that the present genetically limited population of Clatsop Plains silverspots is not able to successfully survive alone on only the 45 acres of productive violet habitat currently available on Camp Rilea. This assumes that 60-100 adult butterflies are needed each year to sustain a genetically viable population, and that prime violet breeding habitat has historically supported an

average of one butterfly per acre. Camp Rilea alone, disregarding the rest of the Clatsop Plains, only had a viable-size population in one year (1991). The abrupt decline in butterfly numbers on Camp Rilea during favorable weather years between 1994 and 1996 is strongly suggestive of a genetic crash due to a bottleneck and inbreeding depression.

The causes behind the population problems of the Oregon silverspot butterfly are somewhat speculative and theoretical, but are based upon the following field observations of Hammond and McCorkle made throughout the Clatsop Plains since 1982 (Hammond & McCorkle, 1982, 1985, etc.).

Two behavioral types of silverspot butterflies are known to have comprised the Clatsop Plains population in the past, a highly vagile type that migrated over long distances and a more sedentary type that remained closer to the breeding habitat. The sedentary type was once common in the Del Rey Beach and Sunset Lake areas, but was never found on Camp Rilea. The great increase in silverspot numbers on Camp Rilea in 1991 resulting from improved habitat management was composed exclusively of the highly vagile, migratory type.

The last sedentary type butterflies were observed in forest fringe areas at Del Rey Beach during the 1989-1990 field seasons, and this genetic type may have become extinct shortly after. Thus since 1990, the Clatsop Plains silverspot population appears to have become genetically impoverished with the loss of sedentary genetic variation, and has been completely limited to the strongly migratory variation. Unfortunately, a vagile type would be at a serious disadvantage if the productive habitat is confined to only a very small part of the Clatsop Plains. Most butterflies reared on Camp Rilea would tend to disperse off to other areas on the Clatsop Plains, never returning to Camp Rilea for successful breeding. The loss of migrating butterflies to the effective breeding gene pool would ultimately lead to a total genetic bottleneck and loss of genetic fitness and viability. This appears to be what has happened to the Clatsop Plains silverspot population.

It must also be emphasized that Oregon silverspot colonies were more or less continuously distributed along the Oregon coast in pre-European times, allowing considerable genetic interchange among them. They were not genetically closed populations. For example, the historical silverspot population at Astoria was probably located on the south-facing hill sides overlooking Youngs Bay, occupying a Cascade Head type of habitat. Likewise, there was likely a Rock Creek type of population on the seaside benches above the beach where the town of Cannon Beach is now located. In pre-European times, there would have been extensive gene flow among the Cannon Beach, Clatsop Plains, and Astoria populations, but the Clatsop Plains population is entirely isolated today.

Genetic variation is very important in these animal populations beyond the need for heterosis or hybrid vigor. All fritillary butterfly species of the genus Speyeria maintain a large range of genetic variation within their population gene pools, variation affecting behavior such as vagility, habitat preferences, wing color variation, and molecular variation such as allozymes. Such variation is probably necessary for the organism to survive across a wide range of environmental variation within its breeding habitat, both spatial variation across the landscape and temporal variation due to fluctuating climatic conditions from year to year. Such variation could help a silverspot population survive better during years with poor weather conditions, as with the bad violet growth year of 1996 at Camp Rilea.

GENETIC AUGMENTATION

As shown in Table 12, there has been a gradual and continuous decline in silverspot numbers at Camp Rilea since 1992. Even though management of 45 prime habitat acres at the camp has been highly successful, the remaining 800+ acres elsewhere on the Clatsop Plains declined in quality during this time. It is believed that a minimum of 100 adult butterflies is necessary to sustain a genetically viable population. With a minimum carrying capacity of one butterfly per prime habitat acre, the 45 butterflies produced at Camp Rilea during the 1993-1994 period would not have been enough to prevent the Clatsop Plains population from going into a genetic bottleneck by 1995, assuming that butterfly reproduction was mostly limited to the camp.

Thus, it is critical to begin a genetic augmentation program to bring in new genetic stock from other silverspot populations to restore the genetic variation lost from the existing Clatsop Plains population. It is hoped that new genetic variation would help increase the habitat carrying capacity through a more genetically vigorous stock of butterflies. For example, if carrying capacity on Camp Rilea's prime habitat could be increased to five butterflies per acre, the camp could support 225 butterflies, which would be a strong self-sustaining population. However, having only one concentrated population of silverspots would make them vulnerable to elimination via a large disturbance event, making the need for silverspots elsewhere on the Clatsop Plains necessary.

A more detailed discussion of a genetic augmentation program is outlined in the 1996 Camp Rilea report (Hammond, 1996). It is felt that a successful genetic augmentation program is a critical step in the successful recovery of a viable population of the Oregon silverspot butterfly on the Clatsop Plains, in conjunction with habitat management programs such as at Camp Rilea. Therefore, genetic augmentation at Camp Rilea is being considered by the USFWS. If approved, an interagency agreement would be developed to describe how the OMD would cooperate with USFWS in this effort, as long as this plan has been approved as well.

MANAGEMENT PROGRAM FOR MEADOW HABITAT

SELECTIVE MOWING OF HABITAT AREAS

As previously discussed, Areas 3, 4, 5, 7, and 9 currently have habitat in prime condition, while Areas 1, 2, 6, 8, and 10 have been undergoing renovation management since 1990. Based upon experimental studies conducted during 1991-1993, it has been concluded that regular mowing is necessary to sustain Oregon silverspot habitat on the Clatsop Plains in good condition. The experimental response of Scotch broom, general meadow vegetation, nectar flowers, violets, and adult silverspot butterflies to either regular mowing or no mowing treatments support this conclusion. Both nectar flowers and violets grow best in low vegetation about 3-5 inches in height, and female silverspot butterflies strongly prefer to oviposit in low vegetation of about the same height. By contrast, exotic grasses such as bent grass and sweet vernal grass usually grow to 10-25 inches in height by mid-summer. In addition, regular mowing is essential for Scotch broom control. By the end of summer, broom bushes usually attain 3-5 feet in height in the absence of mowing. Two mowings are needed to adequately control the spring growth of exotic grasses. Without an early spring mowing, such grasses are so tall by late May that a single late mowing leaves deep windrows of dead hay on the meadow.

Therefore, the recommended management program for the meadow breeding habitat used by silverspot butterflies at Camp Rilea consists of two or three mowing treatments per year; one or two in the spring, and one in the fall. Mowing height should be about 3 inches above the ground. In spring, this low mowing height helps to prevent the vegetation from becoming too tall by late summer, and results in vegetation about 5-7 inches in height by mid-summer when mature silverspot larvae and pupae are present in the habitat. Another purpose of the spring mowing is to control the new growth of grass and Scotch broom. This is particularly important for areas with dense stands of bent grass (Agrostis alba) or Scotch broom. In short, the overall objective of this management effort is to achieve a maximum vegetation height of no more than 10 inches at the end of the growing season during silverspot oviposition in September.

The first mowing can be conducted at any time from April 1 to May 7. Each year prior to the first mowing, management personnel will need to assess the height of the spring growth to decide if and when to mow during this time period. If the grass height exceeds 5 inches in late March, mowing will be needed. It is likely that the April mowing will be required in most years, although cold-winter years may require no mowing until late May. Based upon the experience of extended rainy weather during the spring of 1996, starting the mowing in early April is necessary in order to complete the required mowing by the first week of May.

The second spring mowing (or first in unusually cold-winter years) should be done from the last half of May (after violet monitoring is completed, about May 16) through the first week of June. The May-June (usually second) spring mowing will be needed if the grass height exceeds 5 inches in late May. Since heavy regrowth takes place during May following the first mowing, two spring mowings is very likely and in fact, has occurred at Camp Rilea in almost every year since mowing began. For Areas 2 and 10, the second mowing can be extended through mid-June if necessary. Both areas are renovation areas that have received relatively little ovipositional use by silverspot females to date, and suffer from particularly severe exotic grass problems. Saving these areas for last during the second spring mowing should help relieve scheduling problems and result in much better control of exotic grasses in these areas. Again, no

mowing should be conducted from May 7 to 16 due to violet monitoring, or after the first week in June to avoid killing silverspot larvae (except for Areas 2 and 10).

The third mowing should be conducted during the fall, from the middle of October through December. The purpose of fall mowing is to cut dead vegetation from the summer's growth of grass, particularly bent grass, and to control regrowth of Scotch broom and European beach grass.

This basic management protocol of two or three mowings per year in spring and fall will apply to most management areas, except for a few areas with special values or concerns that require a slightly different approach. Area 9 is located in a residential area where aesthetics are a concern. Areas 4W and 7 have special botanical values, with wild lilies in Area 4W and wild orchids in Area 7. The detailed management program for each area is described below and summarized in TABLE 13.

AREA 1

This is a renovation area and will be treated with the standard three mowings per year in spring and fall. Two access roads will be maintained through Area 1 (see Map 2) for troop training activities. The north road will connect North Neacoxie Road with Valley Way Road. The south road will connect North Neacoxie Road with the Second Causeway Road.

AREA 2

This is a renovation area and will be treated with the standard three mowings per year in spring and fall.

AREA 3

This is a prime habitat area with heavy stands of bent grass. It will be treated with the standard three mowings per year in spring and fall. The existing NBC Chamber building does not pose any conflicts with the adjacent silverspot habitat and will remain in operational use for troop training. A small area of habitat on the east side of North Neacoxie Road does not conflict with training activities to the south over Neacoxie Creek.

AREA 4

Area 4 consists of two distinct subareas that will be managed differently. Area 4W is located on the west face of the sand dune. It has relatively few violets and is most important as a nectaring area for adult silverspot butterflies. However, Area 4W is of major botanical significance. It has the largest population of the leopard lily (Fritillaria lanceolata) in the entire state of Oregon, with thousands of plants blooming in late May. In addition, other members of the lily family also bloom here during June, including nodding onion (Allium cernuum), white brodiaea (Brodiaea hyacinthina), and harvest brodiaea (Brodiaea coronaria). These species are rarely found along the Oregon coast. Unfortunately, mowing during the spring cuts these plants down at the peak of their growth season, so they are unable to bloom.

TABLE 13

MOWING MANAGEMENT SCHEDULE
OREGON SILVERSPOT BUTTERFLY HABITAT
CAMP RILEA, OREGON

AREA 1	Mow three times: April through early May; late May through the first week of June; and mid-October through December.
AREA 2	Mow three times: April through early May; late May through the first three weeks of June; mid-October through December.
AREA 3	Mow three times: April through early May; late May through the first week of June; and mid-October through December.
AREA 4W	Mow once only in the fall (mid-October through December). to be changed.
AREA 4E	Mow three times: April through early May; late May through the first week of June; and mid-October through December.
AREA 5	Mow three times: April through early May; late May through the first week of June; and mid-October through December. No spring mowing will be done when seed needs harvesting in fall.
AREA 6	Mow three times: April through early May; late May through the first week of June; and mid-October through December.
AREA 7	Mow three times: April through early May; late May through the first week of June; and mid-October through December. Spring mowing in alternate years if Scotch broom is eradicated.
AREA 8	Mow three times: April through early May; late May through the first week of June; and mid-October through December.
AREA 9	Mow three times: April through early May; late May through the first week of June; and mid-October through December.
AREA 10	Mow three times: April through early May; late May through the first three weeks of June; and mid-October through December.

Thus, the management protocol for Area 4W is to conduct only one mowing per year during the fall. However, there are some patches of European beach grass in Area 4W, particularly at the south end. These patches should be monitored for expansion, and they may require spring or even summer mowing if it appears that expansion of beach grass is a serious problem.

By contrast, Area 4E on the east side of the sand dune has heavy concentrations of violets, and is a major silverspot breeding area. It also has heavy concentrations of bent grass. Thus, Area 4E will be treated with the standard three mowings per year in spring and fall. A short walk, including steps, will be installed from Pacific Road to the flagpole for access to raise and lower the flag.

AREA 5

This is a prime habitat area. It will be treated with the standard three mowings per year, in spring and fall, unless harvest of seed is required for planting in renovation areas. In this case, Area 5 will not be mowed during the spring, and the resulting hay with mature seed will be harvested in October. In area 5N, the firing positions for the KD Range, the support building, and the access road from Valley Way Road will be improved and maintained for troop training activities, since this does not conflict with the adjacent silverspot habitat. However, the temporary 300 meter firing positions within the silverspot habitat will be ~~removed~~ retained. ~~Units that need to conduct firing from 300 meters will use the Modified Record Fire Range.~~

10/1/98 ORD comments
10/7/98 field integ.

AREA 6

This is a renovation area and will be treated with the standard three mowings per year in spring and fall. The existing practice hand grenade range will be relocated to a non-habitat area yet to be determined.

AREA 7

This area is a prime silverspot breeding area and has heavy stands of established Scotch broom. Thus, it will be treated with the standard three mowings per year in spring and fall. However, Area 7 also has thousands of wild orchids that bloom in June and July, including both Greene's rein-orchid (Habenaria greenei) and ladies-tresses orchid (Spiranthes romanzoffiana). Mowing in spring cuts off the flower stems of the orchids, so they are unable to bloom.

At present, the heavy stands of Scotch broom in Area 7 require the spring mowing for control. However, if the Scotch broom can be eradicated through herbicide treatments, the spring mowing may be done in alternate years instead of every year. This would allow the orchids to bloom in the alternate years with no mowing. Firing positions for the 200 meter KD Range within this area will be improved and maintained. As with Area 5, the temporary 300 meter firing positions within the silverspot habitat will be removed and this training will be provided at the Modified Record Fire Range.

AREA 8

This a renovation area and will be treated with the standard three mowings per year in spring and fall.

AREA 9

This area is located in a residential part of Camp Rilea, and the aesthetic appearance of the habitat during the growing season is a management concern. In Area 9S, the habitat includes the slope in front of one of the Camp Rilea residential sites. The area is located between two small fir trees, but excludes a flat area bordering the driveway. Thus, Area 9 will be mowed three times a year, including two spring mowings, as with most of the other areas. No mowing should be done after the first week in June within the habitat areas. However, the non-habitat flat area bordering the driveway and the area immediately surrounding the residence can be mowed throughout the summer.

AREA 10

This is a renovation area and will be treated with the standard three mowings per year in spring and fall. At present, there are very few nectar flowers in Area 10. Over the long term, native meadow sod containing goldenrod may be transplanted into this area as part of future construction projects on Camp Rilea.

Fire is often used as a management tool for the renovation of native grasslands overgrown with brush, trees, or tall grasses. However, burning of grasslands on the Clatsop Plains is not recommended because:

(1) Silverspot butterfly larvae are killed by burning;

(2) Sand dunes may become exposed and unstable by hot burns that remove most vegetation;

(3) There is danger of wildfire escape;

(4) Burning stimulates the growth and seedling germination of exotic plants such as bent grass and Scotch broom.

As stated earlier, numbers of blooming violets and habitat quality dropped off dramatically in several areas during 1996 and 1997, which corresponds to the cessation of fertilizer use in those areas. Vegetation in general was quite stunted, probably due to low nitrogen levels in the sandy soil. Therefore, experimental applications of fertilizer will be resumed in Area 7 to see if violet growth can be improved in this traditionally high-violet area.

ERADICATION OF SCOTCH BROOM

The experiments with Scotch broom management have shown that mowing suppresses healthy, vigorous bushes, but does not kill the plants. Thus, mowing is employed as the primary

tool for the control of Scotch broom. However, actual eradication may be a desirable management objective over the long term to better reduce competition with native wildflowers. A method of herbicide treatment has proven effective in killing vigorous plants. The bushes are cut off at ground level by hand with a heavy-duty lopper capable of cutting through at least 1 inch of woody trunk. The freshly cut stumps are then treated with a small amount of the herbicide Roundup (glyphosate), which is applied directly to the stumps from a small spray bottle. August and September are the suggested months for this work, since the root systems absorb the herbicide most readily under dry conditions.

In the experiments, the contents of a single 24 oz. spray bottle of Roundup were sufficient to treat two large patches of Scotch broom about 30 feet in diameter. The time required for this work was about two days with one worker. Because this method is labor intensive and time-consuming, any Scotch broom eradication program may be spread out over a number of years, with only a few patches treated each year. This would only require 1-2 days of work per year. If management personnel and other resources can be made available, the eradication program could be accelerated.

Area 7 will be given priority in any Scotch broom eradication program. Elimination of the Scotch broom would allow Area 7 to be mowed during the spring in alternate years, instead of every year (see Area 7 plan previously discussed).

PROPAGATION PROGRAM FOR NATIVE MEADOW VEGETATION

Revegetation of exposed, disturbed sand following construction projects has frequently been a concern at Camp Rilea. In the past, most re-vegetation work was done with exotic species that are not adapted to the sand dune habitat. Bent grass, velvet grass, orchard grass, fescue grass, and rye grass are exotic species that grow and produce seed in early summer, but are usually brown and dead by late summer in the sand dune environment. In sharp contrast, native plants such as sand-dune sedge, sand-dune goldenrod, and aster remain green and growing throughout the summer, and do not produce seed until October. In general, lawns around residential parts of Camp Rilea remain green throughout the summer because of these native sand-adapted plants.

Consequently, native species will be used whenever possible for revegetation of disturbed areas caused by construction projects. Area 5 is relatively free of exotic species such as bent grass, and has excellent populations of sand-dune sedge, sand-dune goldenrod, and aster that could be used as a seed source for re-vegetation projects. During years when seed is needed, Area 5 should not be mowed in the spring. After the seed is mature, in October, Area 5 should be mowed and the resulting hay gathered for placement over the area requiring revegetation.

TRANSPLANTATION PROGRAM OF NATIVE MEADOW SOD

As shown on the Area 10 map, there are two areas with good violet concentrations. However, almost no nectar flowers such as goldenrod are present in Area 10. Heavy use of meadow breeding habitat by adult silverspot butterflies is strongly correlated with the presence of large goldenrod concentrations. Outside of the dotted line areas on the map, the vegetation of

Area 10 largely consists of exotic grasses such as bent grass, velvet grass, and orchard grass that established underneath the previous Scotch broom brush.

The present baseball field is located along Valley Way Road between First Causeway Road to the north and Demo Road to the south (see Map 4). The northern third of this area is covered with extensive populations of sand-dune goldenrod, together with sand-dune sedge and even a few Viola adunca. A construction project may be planned for this area at some time in the future, in which case this native meadow vegetation would be excavated and destroyed.

However, this is the vegetation that is presently needed in Area 10. Rather than destroying this vegetation in future construction, the meadow sod could be rolled up in long strips like lawn sod, and transplanted into Area 10. The presently undesirable exotic vegetation in Area 10, outside of the good violet areas outlined by dots on the map, could be excavated, removed, and replaced with the strips of native meadow sod from the baseball field. In this way, much of the goldenrod on the baseball field could be saved, and instantly transplanted into Area 10 where it is urgently needed for improvement of the silverspot habitat.

A new baseball field will be constructed southeast of the helicopter landing field to replace the present baseball field. A narrow strip of good violet-goldenrod habitat about 200' long by 20' wide exists along the top of the sand dune on the southeast edge of the helicopter field. This dune will be leveled out during construction of the new baseball field. As an experimental pilot project, the sod from this 200'x 20' strip will be rolled up and transplanted into Area 10, as described above.

CONSTRUCTION EASEMENTS

It may be necessary in future years to perform certain construction projects within the silverspot habitat areas. Of particular concern is excavation for placement of underground utility lines for water, electricity, telephones, etc. Thus, a 5-foot easement will be maintained along all roadways through silverspot habitat for this purpose. During excavation, all dirt will be placed upon the existing roadways, and not piled on the adjacent silverspot habitat. Use of construction equipment will also be limited to the roadways. Once the utility line is installed, the 5-foot zone of disturbed area will be allowed to revegetate with the native meadow vegetation. Plants from the adjacent habitat will quickly move back into the disturbed area and native seed/hay from Area 5 will be added to cover the bare areas until native plants become reestablished.

ONGOING MONITORING PROGRAM

An annual monitoring program is needed to assess the progress and success of the Camp Rilea Management Plan, and to provide a yearly population census of Oregon silverspot butterflies. Four important parameters require monitoring: 1) height of general meadow vegetation; 2) numbers of blooming goldenrod patches; 3) densities of blooming Viola adunca; and 4) silverspot butterfly numbers and use of habitat areas.

It is suggested that some casual monitoring of other meadow vegetation should be conducted in each management area to assess problems such as Scotch broom, European beach grass, and bent grass, as well as sensitive meadow plants such as orchids and lilies. Some of the poorer renovation areas such as Area 2 and Area 10 may also require closer attention to vegetative response to the management program. It is likely that monitoring will suggest changes or additions to the program for some habitat areas in future years. For example, wild carrot or Queen Anne's lace was identified as a potential management problem for the first time during the 1997 field season. This may require more detailed investigation in future years.

MONITORING MEADOW VEGETATION

It is important to monitor the height of the general meadow vegetation consisting of grasses, sedges, and herbs during September in order to assess if mowing management objectives were attained within each of the habitat management areas. The objective at the end of the growing season is to have average meadow vegetation about 5-7 inches high, with maximum vegetation no more than 10 inches high. This maximum height is the most important management criterion.

Because vegetation height is quite patchily distributed in natural meadow communities, it is best to subsample three different classes of vegetation height including short, medium, and tall patches of vegetation to give the natural range of height within each management area. Ten measurements should be made at random sites throughout the area for each of the three classes of vegetation height. The range for short, medium, and tall vegetation is then computed from the averages of these three sets of ten measurements.

The vegetation measured for this monitoring consists of the grasses and vegetative herbaceous cover. Tall, isolated flower stems of herbs such as wild carrot and thistles are not included in these measurements unless they form a significant portion of ground cover.

MONITORING GOLDENROD PATCHES

The sand-dune goldenrod usually grows in clonal colonies or patches. Monitoring involves counting the total number of blooming goldenrod patches within each management area during September. This is most easily done by walking along the same transect lines used for monitoring adult silverspot butterflies.

Monitoring is quite easy when the goldenrod patches are mostly isolated from each other, as they are in most management areas. However, goldenrod has spread so extensively in a few

areas such as Area 1 and Area 3 in recent years that the isolated patches have grown together to form a solid ground cover. In this case, a rough estimate is make by counting the numbers of clumped blooming inflorescences within the broader goldenrod ground cover.

MONITORING VIOLA ADUNCA

Densities of Viola adunca will be monitored in each habitat area by counting violet numbers along established, permanent transects. Only mature flowering-size plants are counted along the transects, because most of the food biomass used by silverspot larvae is found in large plants. Violet counts will be conducted during the spring flowering season in May when plants are visually conspicuous. Each transect extends the length of a management area, and is five feet in width. All blooming violets within this five foot zone are counted along the transect.

Small, stunted non-flowering violets should not be counted for several different reasons. First, they are of little significance as food for silverspot larvae. Second, they cannot easily be seen by an observer without sorting through vegetation on the ground. This is both labor-intensive and time-consuming, and is not practical for large scale application. Third, sorting through ground vegetation results in considerable disturbance, and potentially interferes with the effects produced by the habitat management program itself.

Habitat quality is measured by the average number of violets per foot along the transect length. These violet/foot ratios and quality designations are defined as follows:

Violets/foot	Habitat Quality
1.00+	excellent
1.00 - 0.51	good
0.50 - 0.26	fair
0.25 - 0.11	poor
0.10 - 0.00	very poor

Observation of adult silverspot butterfly numbers and female oviposition suggests that reproduction is good in fair to excellent quality violet habitat. Some oviposition is also observed in poor quality habitat, particularly if small isolated concentrations of violets are present. Butterflies do not spend much time in areas with very poor quality violet habitat unless nectar flowers are present.

The locations of the violet monitoring transects in the Camp Rilea management areas are described below, and are shown on Maps 2 through 6.

AREA 1

Transect 1-1 is east-west in direction from N. Neacoxie Road to the forest fringe at the far north end of Area 1 about 60 feet north of large trees in the meadow. Length 112 feet.

Transect 1-2 is east-west in direction from N. Neacoxie Road to the forest fringe. Specifically it is located on the north side of the north jeep trail to the large tree on the west side of the meadow. Length 66 feet.

Transect 1-3 is east-west in direction from Sign 2 at N. Neacoxie Road to the forest fringe in the central part of Area 1 through an old scotch broom zone. Length 212 feet.

Transect 1-4 is east-west in direction from N. Neacoxie Road to the forest fringe at the south end of Area 1 about 30 feet north of the south jeep trail. Length 121 feet.

AREA 2

Transect 2-1 is north-south in direction parallel to N. Neacoxie Road. It extends from the little hill on the north end of Area 2 near the road to the fourth pine tree in the row of trees at the south end of Area 2. Length 280 feet.

Transect 2-2 is similar to 2-1, but runs further west from the third apple tree on the north to the eighth pine tree on the south. Length 330 feet.

Transect 2-3 is located in the narrow finger of habitat south of the row of pine trees and adjacent to the confidence course. It runs from the first pine tree on the north to the road on the south. Length 135 feet.

AREA 3

Transect 3-1 is east-west in direction 50 feet south of the north road. Length 300 feet.

Transect 3-2 is also east-west, but is located further south along the power line. Length 405 feet.

AREA 4

Transect 4-1 is north-south in direction along the east top of the ridge from the first ravine on the north to the brush and trees at the south. Length 450 feet.

Transect 4-2 is north-south in direction from the parking area at the north southward past the flag pole to Demo Road. Length 330 feet.

AREA 5

Transect 5-1 is east-west in direction in the middle of the north area. Length 170 feet.

AREA 6

Transect 6-1 is east-west in direction. It extends from Range Road between the two large trees (middle tree and south tree) near the pistol range east towards the forest fringe in Area 7. Length 330 feet.

AREA 7

Transect 7-1 extends Transect 6-1 to the forest fringe in Area 7. Length 330 feet.

Transect 7-2 is also east-west in direction. It extends from the west corner of Slusher Lake Road to the central trees at the top of the ridge, and then through Area 9W to Pacific Road. Length 220 feet.

AREA 8

Transect 8-1 is north-south in direction. It extends mid-way up the ridge from the road to the eastern-most pine tree on the south. Length 270 feet.

AREA 9

Transect 9-1 is north-south in direction. It extends from Pacific Road in the middle of the slope southward for 195 feet.

AREA 10

Transect 10-1 is east-west in direction through the north patch of violets. It extends from 10 feet on the east side of the trail to 30 feet on the west side of the trail. Length 40 feet.

Transect 10-2 is east-west in direction through the south zone of violets, extending from the trail to the largest spruce tree in the central area bordering Sunset Lake. Length 100 feet.

Transect 10-3 is east-west in direction through the south zone of violets, extending from the trail to the third spruce tree from the south fence bordering Sunset Lake. Length 100 feet.

MONITORING SILVERSPOT BUTTERFLIES

A monitoring program for adult silverspot butterflies will also use regular transects through each of the habitat areas. The locations of these transects are illustrated by single and double lines on Maps 2 through 6. Transects follow a straight line in small areas, and a circular route in large areas so that all butterflies within an area may be observed and counted. Monitoring will be done three days per week from the last week in August until the first of October, since this is the time when female butterflies return to the meadow breeding habitat for oviposition.

When walking the transects, weather conditions should be reasonably warm and at least partly sunny. Not all areas on Camp Rilea are equally affected by strong winds blowing off the ocean, so field personnel will need to judge conditions in each area before walking the transects. This should be conducted at a slow pace, perhaps 200 feet in 5 minutes, so that butterflies resting in the vegetation have time to fly up and be counted.

Silverspot females change their activities during different parts of the day. Nectaring takes place in mid-morning (1000-1130) and again in late afternoon (1530-1730). The middle

part of the day is spent in oviposition. When conducting the census, the observer should record butterfly behavior, either nectaring or oviposition. If time permits, each transect should be worked twice per day, in mid-day during the oviposition period, and in morning or late afternoon during the nectaring period. Census counts are actually most accurate during the nectaring period, since butterflies are often hidden in vegetation on the ground during oviposition. If two transect counts are made per day, the highest of the two counts will be recorded as the final count for the day.

It may also be desirable to observe adult silverspot butterflies outside of the oviposition season in July and August, particularly males using the forest fringe areas as mating territories. This aspect of silverspot biology will require additional study at Camp Rilea as the breeding habitat improves and butterfly numbers increase in future years. However, mid-summer studies do not need to be done every year.

In addition, female oviposition activity will be monitored once per week within the 15 acres of violet habitat located outside the designated habitat management areas, primarily on the firing ranges along Valley Way Road and on the helicopter landing field. This will assess any change in the silverspot use of these areas.

FREQUENCY OF MONITORING

Detailed monitoring of meadow vegetation, goldenrod, violets, and silverspot butterflies has been conducted at Camp Rilea every year from 1991 to 1997. This level of monitoring will continue for the first five years following formal acceptance of this management plan in order to assess the progress of the meadow management program. Other vegetation problems such as Scotch broom, bent grass, European beach grass, and wild carrot will also be evaluated at the same time. Monitoring frequency will be reviewed and possibly reduced after the five year period if violet and silverspot numbers have reached satisfactory levels in most of the management areas. However, a limited census during the four weeks of September will still be valuable in future years to monitor the health and stability of the population.

PROJECTED EFFECTS OF HABITAT MANAGEMENT AT CAMP RILEA

Based upon studies by the U.S. Forest Service, there is a lag time of 2-5 years after the start of habitat renovation before Oregon silverspot butterflies begin using newly managed habitat in large numbers (Hammond, 1993). Those studies showed that renovated grassland treated for thatch or braken fern invasion required only 2 years before heavy butterfly use was observed. However, grassland overgrown with heavy brush or tree cover required 4-5 years of renovation before heavy butterfly use occurred.

Of the 63 total acres of habitat management area at Camp Rilea, about 24 acres were in fair to excellent condition at the start of the management program in 1990. Fair to excellent condition is considered to be prime habitat. As a result of the renovation work, this number increased to 34 acres by the end of 1993, and is expected to reach 45 acres by the year 2000. It should be noted that these numbers may be depressed in some years due to temporary environmental factors such as drought.

As discussed by Hammond (1988a), only small numbers of adult silverspot butterflies have been observed on Camp Rilea in the past, including 8 females in 1985 and 3 females in 1988. Male butterflies had never been seen at Camp Rilea. Despite heavy oviposition in the violet areas, reproduction has been very poor, and many adult females were probably migrants from the Sunset Lake area to the south. Most silverspot larvae apparently did not survive the heavy mowing and other disturbance in the breeding areas at Camp Rilea through the summer growing season.

However, with the changes in management efforts previously described, many more adult silverspots were seen at Camp Rilea in 1991. The first butterfly was a freshly eclosed, teneral male in Area 7S on July 11. On August 5, two males were nectaring on false dandelion in Area 1, while a fourth male was seen in Area 1 on August 9. A fifth male was seen in the forest fringe zone at the junction of Tank Hill Road and Gammagoat Road, basking in the sun.

It is estimated that only 6-10 silverspot butterflies were present in the Camp Rilea area in 1988. With the end of mid-summer mowing in the 24 acres of prime habitat, butterfly numbers dramatically increased to an estimated 40-60 individuals in 1991. Since then, numbers have been reduced to an estimated 20-40 individuals in 1992 and 15-30 individuals in 1993 and 1994. This is probably due to adverse weather conditions and declining habitat quality outside of Camp Rilea. Nevertheless, there were three times as many butterflies in 1993 and 1994 as in 1988 at Camp Rilea. Moreover, butterflies had begun to use some of the renovation areas in large numbers by 1993 and 1994, particularly Area 1. Based upon this information, it is estimated that prime breeding habitat on the Clatsop Plains will produce about 1 butterfly per acre during bad years with adverse weather conditions, and perhaps 2-3 butterflies per acre during good years. It is useful to look at each management area on Camp Rilea with regard to its potential to produce butterflies in the past, the present, and the future.

AREA 1

Area 1 is a renovation area with 9.40 acres. No butterflies were seen before management. About 5 acres are now in prime condition, and at least 6 acres should be prime by 2000.

AREA 2

Area 2 is a renovation area with 4.96 acres. No butterflies were seen before management. Conditions are still poor to very poor, but it is hoped that 2 acres will reach prime conditions by the year 2000.

AREA 3

Area 3 is a prime area with 6.81 acres. No butterflies were present before management, apparently because of the intensive mowing.

AREA 4

Area 4 has about 4 acres of prime habitat out of a total 8.12 acres. Hopefully 6 acres will be in prime condition by the year 2000. Butterflies have been present since 1985.

AREA 5

Area 5 is a prime area with 4.66 acres. Butterflies have been present since 1985.

AREA 6

Area 6 is a renovation area with 4.31 acres. About 3 acres are now in prime condition; about 4 acres should be prime by the year 2000. No butterflies were present before management.

AREA 7

Area 7 is a prime area with 6.28 acres. Butterflies have been present since 1985.

AREA 8

Area 8 is a renovation area with .87 acres. No butterflies were present before management. The area is now in fair condition and should be good to excellent by 2000.

AREA 9

Area 9 is a prime area with 2.62 acres. No butterflies were present before management, apparently because of the intensive mowing.

AREA 10

Area 10 is a renovation area with 15.41 acres. One butterfly was seen in this area in 1985 and a female was observed ovipositing in 1995. At present, there are about 6 acres of good violet

habitat. The rest consists of degraded, exotic grassland. No nectar flowers such as goldenrod are currently available.

TABLE 14 shows actual and projected numbers of silverspots at Camp Rilea and illustrates the effects of habitat management, assuming production of one butterfly per acre of prime habitat. Prime habitat areas in 1988 produced few butterflies because of the heavy mid-summer mowing. Habitat management at Camp Rilea resulted in three times more butterflies by 1992, which is felt to be a representative year. By the year 2020, silverspot numbers are expected to increase to almost five times the pre-management number. Assuming no management at all, including the maintenance of training areas, all habitat is expected to be overgrown with Scotch broom brush by the year 2020, and no butterflies will exist on Camp Rilea. It should be noted that the projected butterfly numbers assume the existence of a genetically viable population of close to 100 adults for the whole Clatsop Plains, which may not have existed since 1993.

TABLE 14

ACTUAL AND PROJECTED NUMBER OF SILVERSPOTS BY HABITAT AREA WITH AND WITHOUT MANAGEMENT*

	(no mgmt.) 1988	(mgmt.) 1992	(mgmt.) 2020	(no mgmt.) 2020
Area 1	0	6	9	0
Area 2	0	0	3	0
Area 3	0	2	6	0
Area 4	2	4	6	0
Area 5	2	2	5	0
Area 6	0	0	4	0
Area 7	6	16	7	0
Area 8	0	0	1	0
Area 9	0	6	2	0
Area 10	0	0	5	0
Totals	10	36	48	0

* Actual numbers are based on observations. Projected numbers assume production of one butterfly per acre of prime habitat and that no mowing (mgmt.) equals no prime habitat.

POTENTIAL BUTTERFLY "TAKE" FROM CAMP RILEA ACTIVITIES

One way to assess potential take of Oregon silverspot butterflies is to consider the amount of violet breeding habitat that may be impacted by various activities at Camp Rilea. At present, there are about 61 acres of violet habitat on Camp Rilea. Of this, about 45.55 acres are included in the management areas previously described, with about 15 acres outside of the management areas. An additional 17.89 acres of meadow habitat with few or no violets at present are also included within the designated management areas, primarily in Areas 1, 2, 4W, and 10. TABLE 15 illustrates this division as productive acres with violets and non-productive acres with few or no violets.

TABLE 15

HABITAT MANAGEMENT AREAS, PRODUCTIVE HABITAT WITH VIOLETS, and NON-PRODUCTIVE HABITAT WITH FEW OR NO VIOLETS (ESTIMATES BASED ON 1994 DATA)

AREA	TOTAL ACRES	PRODUCTIVE ACRES	NON-PRODUCTIVE ACRES
1	9.40	6.00	3.40
2	4.96	2.00	2.96
3	6.81	6.81	0.00
4	8.12	6.00	2.12
5	4.66	4.66	0.00
6	4.31	4.31	0.00
7	6.28	6.28	0.00
8	0.87	0.87	0.00
9	2.62	2.62	0.00
10	15.41	6.00	9.41
TOTALS	63.44	45.55	17.89

VIOLET HABITAT OUTSIDE MANAGEMENT AREAS

During 1996, a detailed survey was made of violet habitat on Camp Rilea outside of the designated silverspot management areas. This survey identified about 15 acres of violet habitat outside of the management areas, most of it being located along the edges of the firing ranges bordering Valley Way Road (see Appendix 3). Management on and around the firing ranges has included clearing away Scotch broom brush and mowing the tall, dense grasses. Violets have responded quite favorably to this management just as in the silverspot habitat management areas. Violets in these areas tend to be sporadic, either solitary plants or in small patches.

Only three dense concentrations of violets were observed outside of the habitat management areas. One location is a narrow strip on top of the sand dune on the east edge of the helicopter landing field. A second site is a small 30-foot-wide patch of violets along Pacific Road north of the sewage lagoons. The third area is a larger strip on the west side of Valley Way Road on the Law Range and M203 Range. All of these areas together comprise less than one acre.

Areas with sporadic violets outside of the habitat management areas were found in four locations. One area is adjacent to Habitat Management Area #1 on the east side of Neacoxie Road adjacent to a wetlands. This area is full of sinkholes related to the wetlands and cannot be managed with mechanical equipment. A second area is located around the edges of the firing ranges bordering Valley Way Road, including the edges of the Law Range, M203 Range, Infantry Squad Live Fire Range, Indirect Fire Range, and the south end of the Modified Record Fire Range. The third area is found around the western edge of the Baseball Field/Night Compass Course. The fourth area is the helicopter landing field.

Violets are scarce in the latter three areas, and the habitat is very poor for the silverspot butterfly at the present time. Adult silverspots have rarely been seen in any of these poor quality areas over the years. Nevertheless, continued management (i.e., mowing) will likely result in a gradual increase in violet numbers in these areas over time, and greater silverspot use may begin to occur in another 10 to 20 years. However, there should still be little conflict with military training activities on the firing ranges, since range use does not result in trampling of concentrated violet habitat.

Potential incidental take of Oregon silverspot larvae or pupae could result in any of the above areas from normal operations such as heavy lawn mowing through the summer or trampling during troop training. However, the probability of such potential take is considered to be quite low, because female silverspot butterflies would have a low probability of discovering and ovipositing within violet patches less than 50 feet in diameter. Indeed, experience has shown that female silverspot butterflies prefer to concentrate their oviposition activities in large, contiguous areas of violet habitat such as Area 7 (see TABLE 12).

At some future time, violets in these small patches may eventually multiply and spread into larger patches greater than 50 feet in diameter, or they may multiply in entirely new areas of Camp Rilea such as the firing ranges. If future monitoring shows that significant silverspot butterfly oviposition is taking place in these new violet areas, possibly resulting in heavy mortality of larvae from summer mowing or trampling, the OMD may engage in additional

consultation with the USFWS, and may propose a project to transplant the sod from these violet areas into one of the silverspot butterfly management areas such as Area 10.

VIOLET HABITAT WITHIN MANAGEMENT AREAS

A very small amount of incidental take of silverspot larvae may take place within the 45.55 acres of violet habitat included in the management areas in conjunction with necessary monitoring and management of the habitat. These activities include the monitoring of violets, butterflies, and meadow vegetation, plus management work such as mowing three times per year, topical application of herbicide to patches of Scotch broom, native hay/seed collection within Area 5, and transplantation of nectar flower/violet sod into Area 10.

TROOP TRAINING ADJACENT TO MANAGEMENT AREAS

Violet habitat within the designated management areas will not be used directly for Camp Rilea operations, including military training. (The Hand Grenade Range in Area 6 will continue to be used until it is relocated.) However, these areas will be incorporated into training scenarios as avoidance areas (e.g., minefields, friendly forces, etc.). In addition, troop operations will continue adjacent to some of the management areas as outlined below. These operations are not expected to have any impact upon the adjacent habitat, so there should be little or no incidental take of silverspot larvae as a result.

AREA 1

Troops will continue to use the two existing roadways through Area 1.

AREA 3

Troops will continue to use the existing NBC Chamber building adjacent to Area 3.

AREA 4

Troops will continue to use the proposed walk to raise and lower the flag adjacent to Area 4.

AREA 5

Troops will continue to use the existing access road, support building, and firing positions for the rifle range adjacent to Area 5.

AREA 6

Troops will use the proposed foot path at the south boundary of Area 6 adjacent to the habitat.

PESTICIDE USE AT CAMP RILEA

No herbicides will be used in habitat management areas for the Oregon silverspot butterfly except for the topical application of herbicide to control patches of Scotch broom, as previously discussed.

No insecticide sprays will be used on Camp Rilea at any time of the year within 500 feet of any silverspot management area. In addition, no insecticide sprays will be used anywhere on Camp Rilea during the adult silverspot flight season of July 15 to October 1. Insecticide sprays may be used to control mosquitoes and other outdoor pests at other times of the year as long as the above restrictions are observed. Within buildings insecticides may be used as desired to control termites, carpenter ants, or other pests.

These measures should result in little or no incidental take of Oregon silverspot butterflies at Camp Rilea due to pesticide use.

FUTURE CONSTRUCTION IN MANAGEMENT AREAS

The present Habitat Management Plan anticipates that some Oregon silverspot butterflies may be killed (only as larvae or pupae) as a consequence of necessary construction on Camp Rilea. Such take would result primarily from excavation during installation and/or maintenance of underground utility lines for water, electricity, telephones, etc. For this purpose, a five-foot construction easement will be maintained along all roadways through silverspot habitat. All excavated dirt and construction equipment will be limited to the roadways, and will not impact adjacent silverspot habitat beyond this 5-foot easement. The total habitat area to be included within the five-foot construction easement totals 1.31 acres as detailed in TABLE 16.

However, there is a low probability of construction taking place along the road margins of Areas 1, 4W, and 5N, and if construction were to take place, it might be easily placed on the side of the road opposite to the habitat. This means that a total of 0.59 acres will probably never require construction disturbance, leaving 0.72 acres within the construction easement that have a high probability of disturbance during future construction projects. Moreover, the butterfly-producing potential of the habitat within the five-foot construction easement will not be permanently lost to the butterflies. After construction is completed, the disturbed area will be allowed to re-vegetate with native meadow plants, including violets, and can be planted with native seed if necessary. Consequently, the take of silverspot butterflies will only be temporary, and will not permanently diminish total silverspot habitat on Camp Rilea or the silverspot population itself.

Construction disturbance will also briefly affect Area 6 when the Hand Grenade Range is removed. This action should impact this area only a single year, and will ultimately improve the quality of the habitat. Improvement and maintenance of the KD Range adjacent to Areas 5 and 7 will not affect habitat there.

TABLE 16

AREA IN ACRES WITHIN THE 5-FOOT CONSTRUCTION EASEMENT FOR EACH HABITAT MANAGEMENT AREA

Area	Total Acres	5 Foot Zone (Acres)
1	9.40	.27
2	4.96	.06
3	6.81	.24
4E	4.20	.03
4W	3.92	.18
5S	1.84	.04
5N	2.82	.14
6	4.31	.06
7N	4.86	.06
7S	1.42	.04
8	.87	.03
9N	.89	.06
9W	.86	.05
9S	.87	.05
10	15.41	.00
Total	63.44	1.31

There is one current source of potential incidental take of silverspot larvae at Camp Rilea. This involves raising and lowering the flag and firing a cannon each day at the flag pole in Area 4E. A tractor pulls the cannon to and from the flag pole area only 4 times a year, and is a very minor disturbance. However, a squad of ten people march from Pacific Road to the flag pole across Area 4E twice a day to raise and lower the flag. This results in a considerable amount of disturbance. Thus, Camp Rilea proposes to reduce this disturbance and potential incidental take by installing a short walk from Pacific Road to the flag pole. This walk will include a series of steps up the steep slope bordering Pacific Road, and will be 8 feet wide and approximately 60 feet long. Construction of this walk will permanently eliminate 0.01 acres of violet habitat from Area 4E.

SUMMARY

It is anticipated that some incidental take of silverspot larvae or pupae will take place at Camp Rilea in the future with construction projects along the roadsides, with expansion of

violets and silverspot butterflies into areas of Camp Rilea that are currently not habitat, and with the flag pole activities described above. Some of this take would probably result from work along the five-foot construction easements, and is estimated at a maximum of 1.31 butterflies, assuming production of one butterfly per acre of habitat. Additional take from training activities on the firing ranges and elsewhere outside of the silverspot management areas is estimated at a maximum of 2-3 butterflies per year. Because construction is a one-time event, potential take from all sources of disturbance is estimated at a maximum of 2-3 butterflies per year during the next twenty years, although this could change in the long-term future if violets eventually spread over many acres that are currently poor or non-habitat.

It should be noted that take will actually consist of killing larvae or pupae, with the possible reduction of 2 to 3 butterflies in the adult population for a given year. As a mitigation against this incidental take of 2 to 3 butterflies, Camp Rilea is proposing to manage 63 acres of silverspot butterfly habitat, as previously described. This management has increased butterfly numbers on Camp Rilea from an estimated 10 butterflies in 1988 to approximately 40 butterflies in 1992. However, the alternative of no management will likely lead to all habitat areas on Camp Rilea becoming over-grown with Scotch broom brush over time, and butterfly numbers would likely drop to zero by the year 2020 (see TABLE 14).

TABLE 17 summarizes the actions at Camp Rilea that may be expected to impact violet breeding habitat of the Oregon silverspot butterfly in future years. As part of this Habitat Management Plan, only 0.01 acres of violet habitat will be permanently lost from the management areas due to construction of the flagpole walk in Area 4E. The 0.01 acres of violet habitat at the helicopter field will not be lost, but will be added by transplantation to Area 10.

The costs of implementing this management plan are approximately $15,000 per year, not counting staff time. Monitoring costs are about $10,000 and mowing costs $5,000. Other activities, such as fertilizing and Scotch Broom removal, will be accomplished with Camp Rilea staff and/or volunteers.

TABLE 17
SUMMARY OF IMPACTS TO HABITAT FROM MANAGEMENT AND NON-MANAGEMENT ACTIVITIES

MANAGED HABITAT Total Area: 63.44 acres	TIME	FREQUENCY	DURATION	INTENSITY	TOTAL AREA* (acres)	VIOLET HABITAT** (acres)	AFFECTED HABITAT (acres)
1. CONSTRUCTION							
a. Flagpole Walk (4E)	1	1x	permanent elimination		0.01	0.01	- 0.01
b. Grenade Range (6)	2,3	1x	5 days	5 people 2 trucks	1.50	1.50	1.50
c. Utility Lines (all)	1	1x/10 years	5 days	10 people 4 trucks	63.44	45.55	1.31
2. HABITAT MANAGEMENT							
a. Mow (all)	2,4,5	3x/year	15 days	1 person 1 tractor	63.44	45.55	45.55
b. Meadow Seed (5)	2	as needed	1 day	1 person 1 tractor	4.31	4.31	4.31
c. Broom Herbicide (all)	7,8	as needed	1-4 days	1-2 people	0.5	0.5	0.5
d. Nectar Transplant (10)	2,3	1x	1 day	2 people 2 trucks	0.1	0.0	+ 0.1

TABLE 17 (continued)
SUMMARY OF IMPACTS TO HABITAT FROM MANAGEMENT AND NON-MANAGEMENT ACTIVITIES

	TIME	FREQUENCY	DURATION	INTENSITY	TOTAL AREA* (acres)	VIOLET HABITAT** (acres)	AFFECTED HABITAT (acres)
3. HABITAT MONITORING							
a. Violets (all)	4	2x/year	4 days	1-2 people	63.44	45.55	45.55
b. Butterflies/Vegetation (all)	7,8	1x/year	6 weeks	1-2 people	63.44	45.55	45.55
c. Mid-Summer Census (all)	7	1x/2-3 years	2 weeks	1-2 people	63.44	45.55	45.55
NON-MANAGED HABITAT AREAS Total Area: 15 acres	TIME	FREQUENCY	DURATION	INTENSITY	TOTAL AREA* (acres)	VIOLET HABITAT** (acres)	AFFECTED HABITAT (acres)
1. SINKHOLES	none	none	none	none	NA	0.5	0.0
2. HELICOPTER FIELD	2,3	1x	relocation to Area #10		NA	0.1	- 0.1
3. LAWN/TRAINING AREAS	1	variable	variable	variable	NA	14.4	-14.4***

DESCRIPTION OF ENTRIES:

1 = All Year
2 = Mid Oct - Nov
3 = Dec - Mar
4 = Apr - May
5 = Late May - Early June
6 = Jun -Early July
7 = Jul - Aug
8 = Sep - Early Oct

* TOTAL AREA includes all land within the identified habitat management areas, regardless of the presence of violets.

** VIOLET HABITAT identifies only those portions of the identified management areas which contain violets.

*** only 0.5 acres have concentrated violets.

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APPENDIX 1

DEFINITIONS OF SELECTED TERMS

Adult Habitat. Areas where adult butterflies fly, nectar on flowers, lay eggs, use forest fringes, etc. Virtually all of Camp Rilea is within the flying zone of adult Oregon Silverspot Butterflies and is therefore adult habitat.

Forest Fringe Habitat. Part of the adult habitat on Camp Rilea where adult male Oregon Silverspot Butterflies are likely to establish mating territories.

Violet Breeding Habitat. Meadow habitat on Camp Rilea that supports Viola adunca, and where the breeding stages of the Oregon Silverspot Butterfly occur including eggs, larvae, pupae, and adults.

Prime Violet Habitat. Violet habitat that has always been managed by Camp Rilea as grasslands, such as lawns.

Renovation Violet Habitat. Violet habitat that was previously overgrown with Scotch broom brush and was never managed for silverspots by Camp Rilea until 1990.

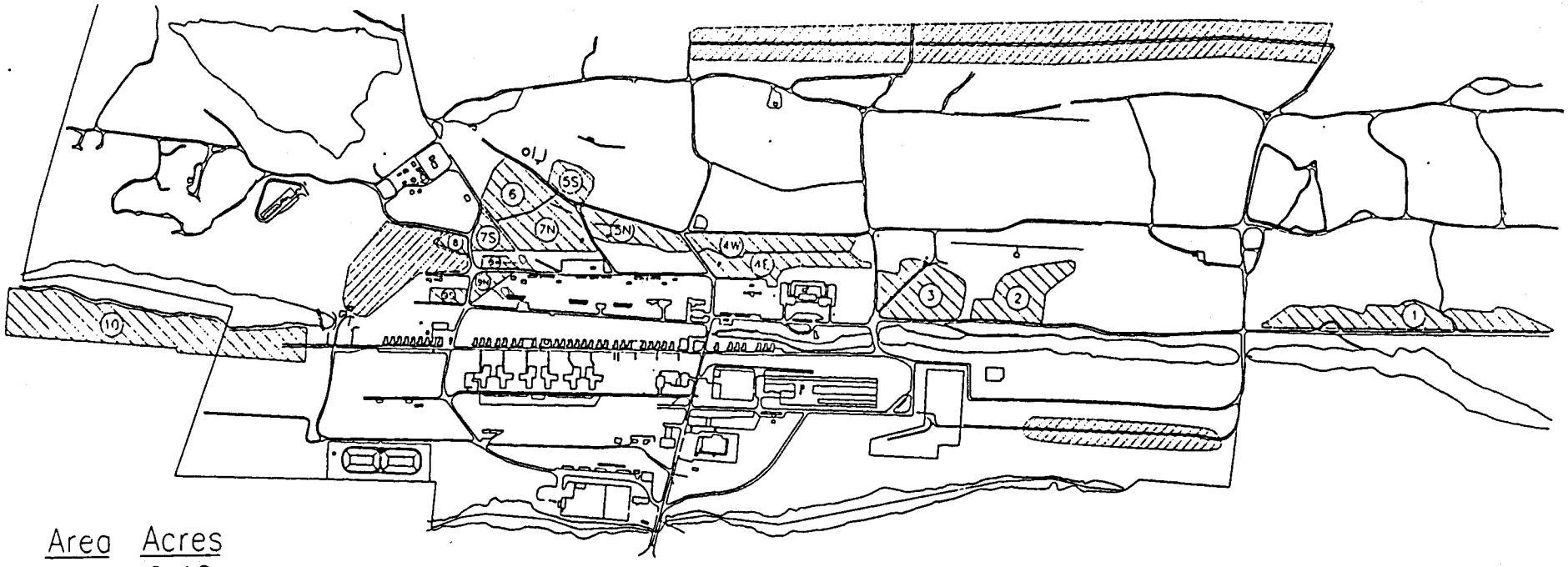
Habitat Management Areas. Areas that are specifically designated and managed by Camp Rilea as violet breeding habitat for the Oregon Silverspot Butterfly.

Meadow Ecosystem. Natural grassland community at Camp Rilea consisting mostly of native plants and animals including wild flowers, insects, and vertebrate animals.

Take. An Endangered Species Act term for the killing of the Oregon Silverspot Butterfly at any of its life stages including eggs, larvae, pupae, and adults.

APPENDIX 2

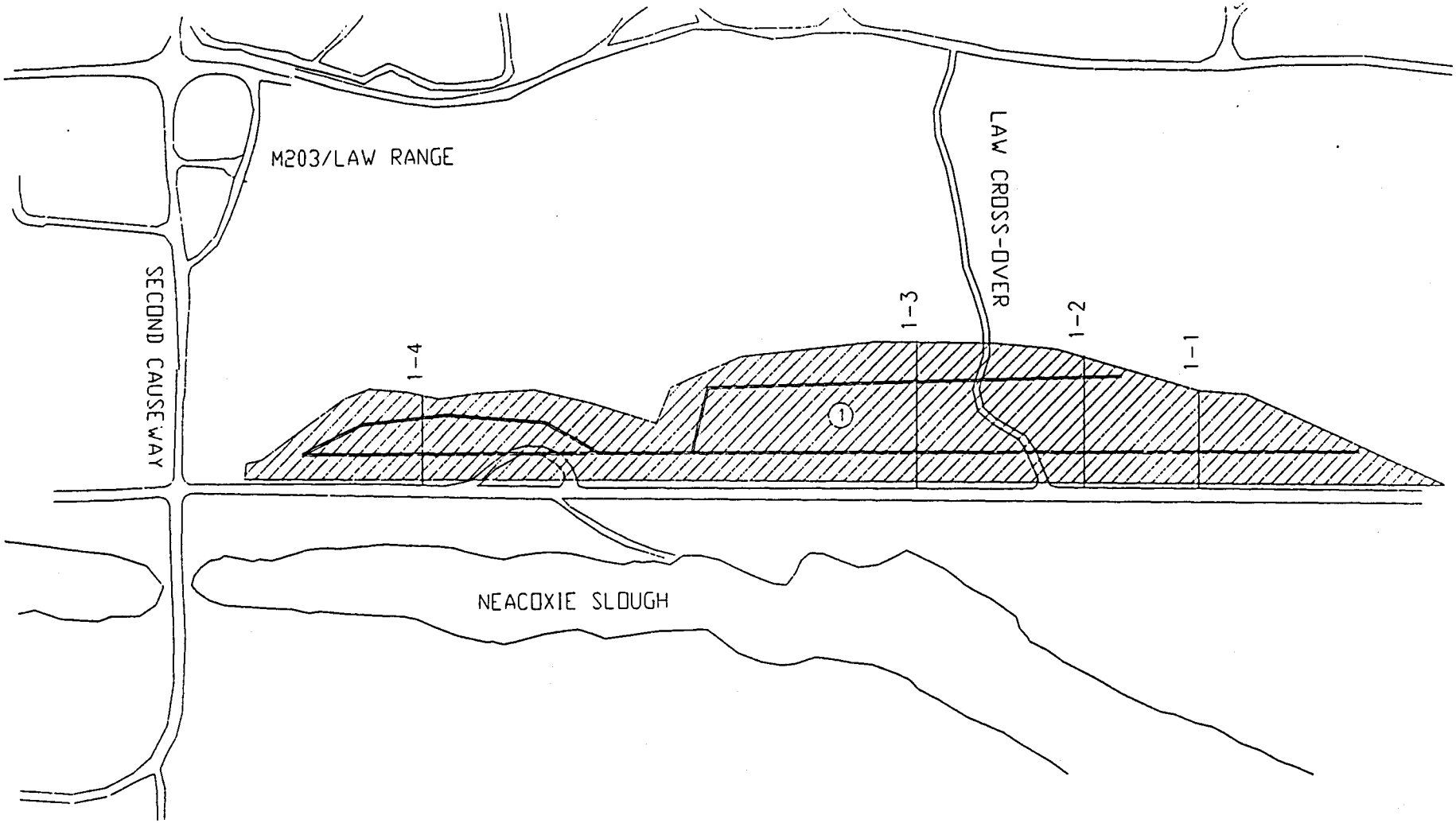
MAPS OF CAMP RILEA HABITAT MANAGEMENT AREAS



Area	Acres
1	9.40
2	4.96
3	6.81
4E	4.20
4W	3.92
5S	1.84
5N	2.82
6	4.31
7N	4.86
7S	1.42
8	0.87
9N	0.89
9W	0.86
9S	0.87
10	15.41
Total	63.44

Forest Fringe Habitat
Violet Habitat

SCALE: NTS DATE: 04/17/95 DRAWN: GGL FILE: SIL_1	RILEA ARMED FORCES TRAINING CENTER RT 2, BOX 497-E WARRENTON, OREGON 97146-9711 TITLE: MAP 1 HABITAT MANAGEMENT AREA



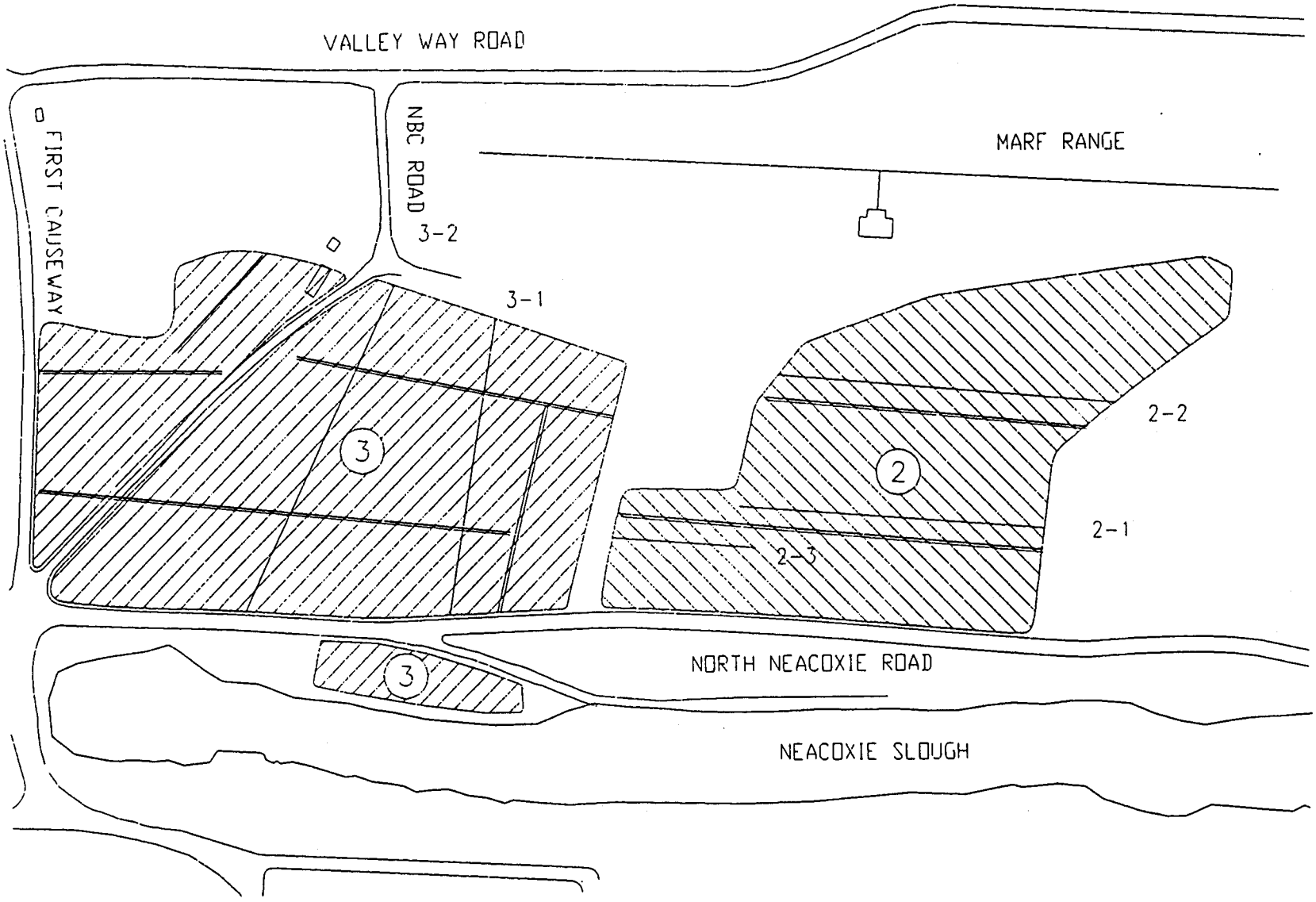
AREA 1 = 9.40 AC

VIOLET TRANSECTS
BUTTERFLY TRANSECTS

SCALE: 1" = 300'
DATE: 04/17/95
DRAWN: GGL
FILE: SIL_2A

RILEA ARMED FORCES TRAINING CENTER
RT 2, BOX 497-E
WARRENTON, OREGON 97146-9711

TITLE: MAP 2
HABITAT MANAGEMENT AREA 1



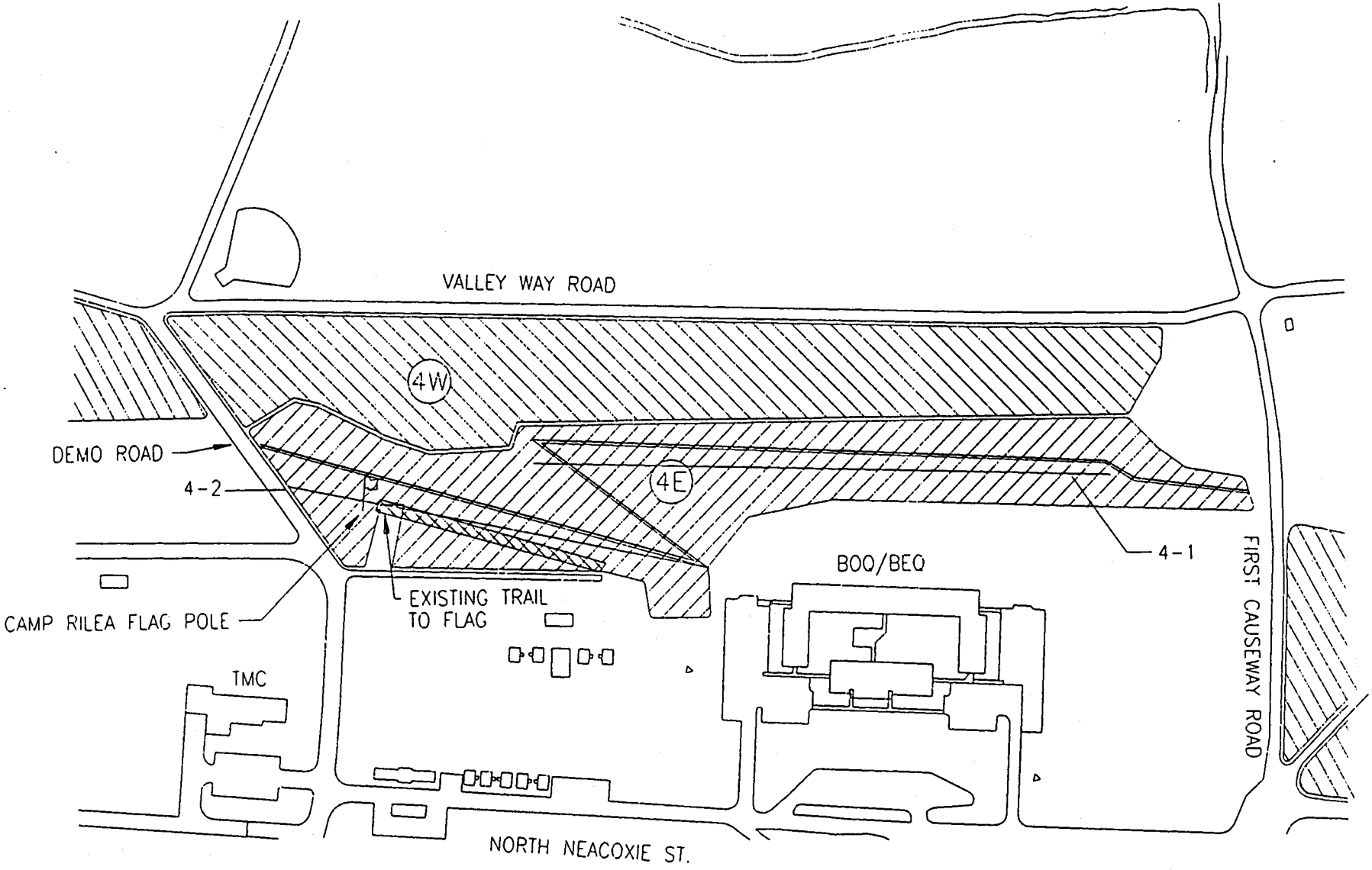
AREA 2=4.96 Ac
AREA 3=6.81 Ac

VIOLET TRANSECTS
BUTTERFLY TRANSECTS

SCALE: 1" =200'
DATE: 04/17/95
DRAWN: CGL
FILE: SIL_3A

RILEA ARMED FORCES TRAINING CENTER
RT 2, BOX 497-E
WARRENTON, OREGON 97146-9711

TITLE: MAP 3
HABITAT MANAGEMENT AREA 2 & 3



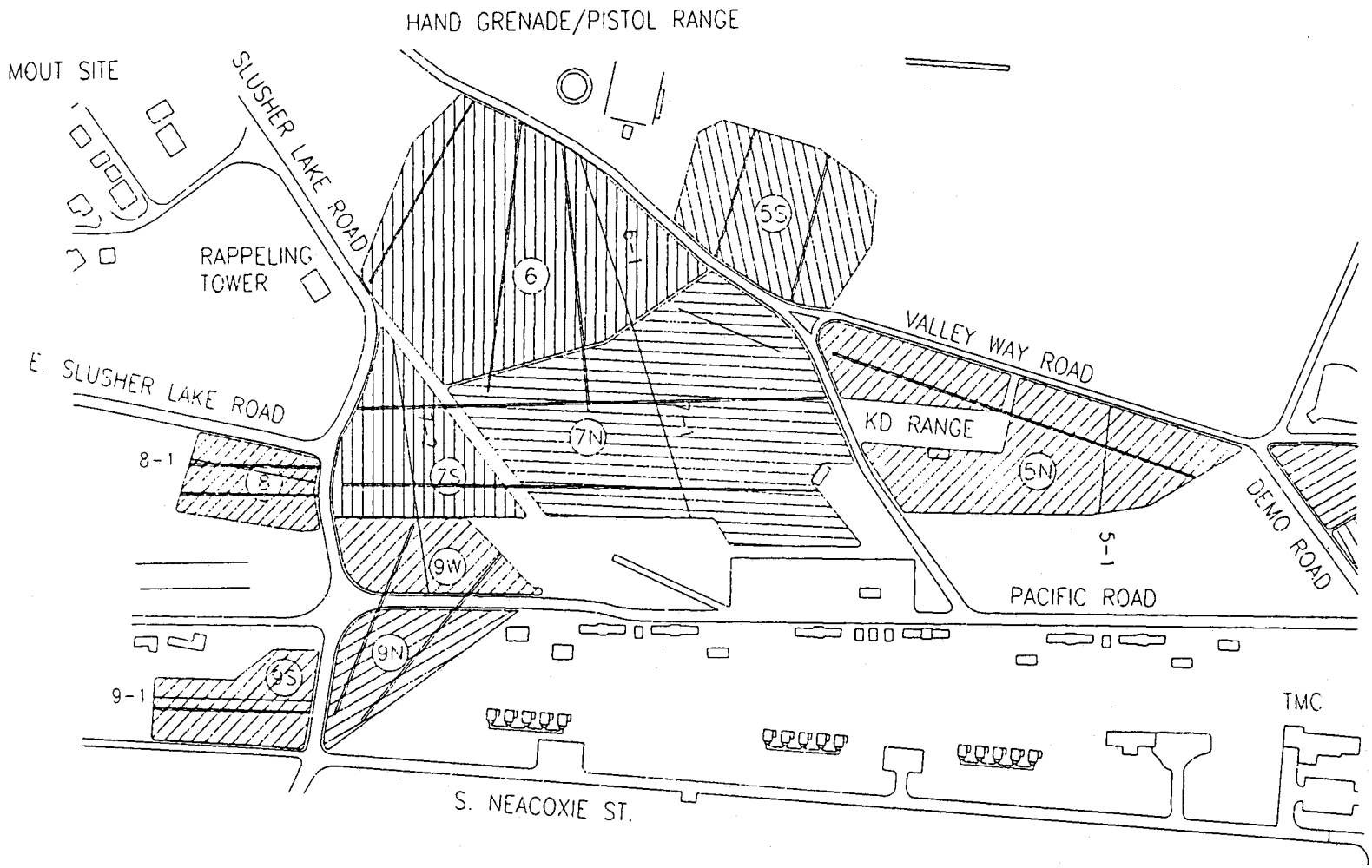
AREA 4W=3.92 Ac
AREA 4E=4.20 Ac

VIOLET TRANSECTS
BUTTERFLY TRANSECTS

SCALE: 1" =200'
DATE: 04/17/95
DRAWN: GGL
FILE: SIL_4A

RILEA ARMED FORCES TRAINING CENTER
RT 2, BOX 497-E
WARRENTON, OREGON 97146-9711

TITLE: MAP 4
HABITAT MANAGEMENT AREA 4



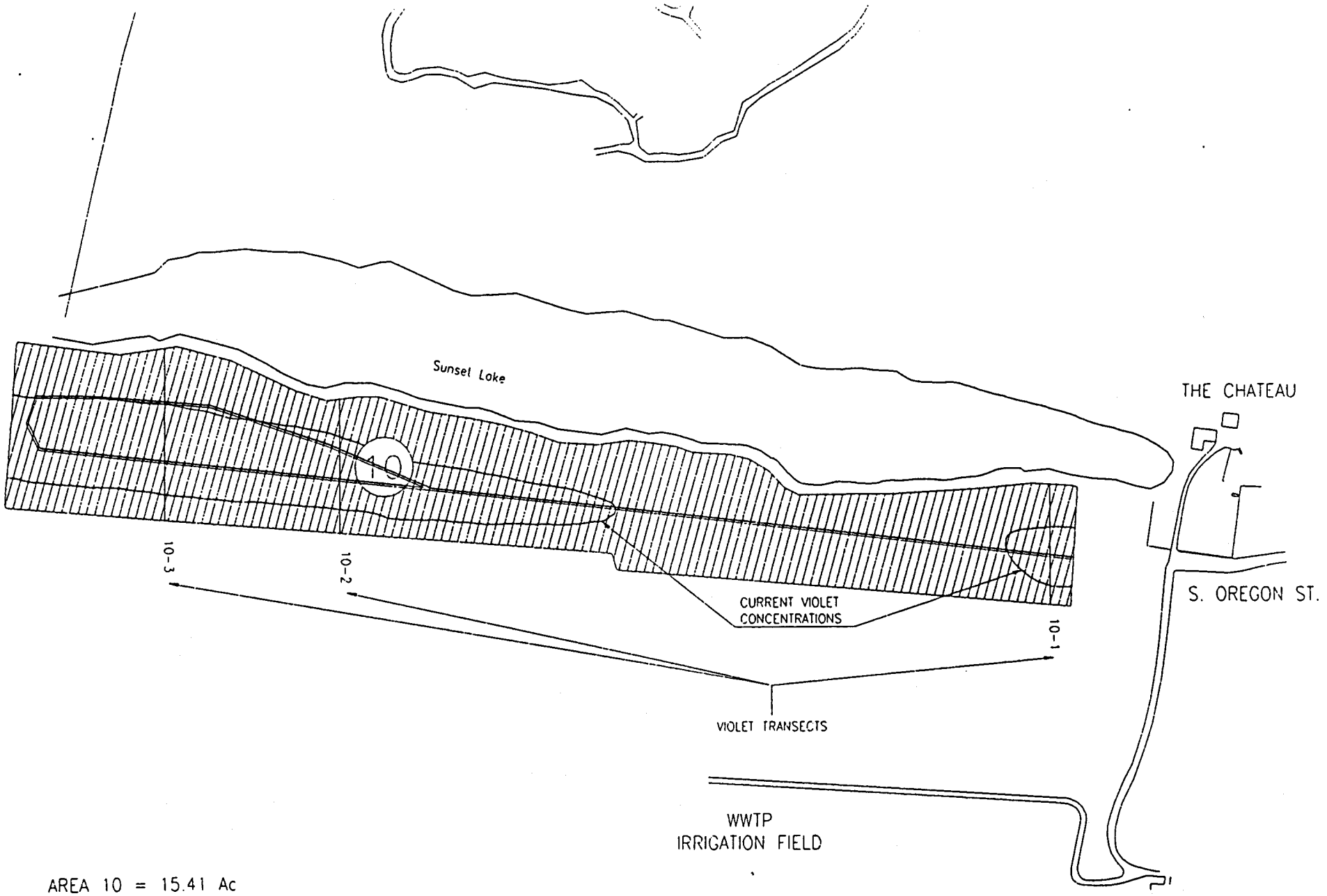
AREA 5S= 1.84 Ac
AREA 5N= 2.82 Ac
AREA 6 = 4.31 Ac
AREA 7N= 4.86 Ac
AREA 7S= 1.42 Ac
AREA 8 = 0.87 Ac
AREA 9N= 0.89 Ac
AREA 9W= 0.86 Ac
AREA 9S= 0.87 Ac

VIOLET TRANSECTS
BUTTERFLY TRANSECTS

SCALE: 1" = 300'
DATE: 04/17/95
DRAWN: GGL
FILE: SIL_5A

RILEA ARMED FORCES TRAINING CENTER
RT 2, BOX 497-E
WARRENTON, OREGON 97146-9711

TITLE: MAP 5
HABITAT MANAGEMENT AREA 5,6,7,8 & 9



AREA 10 = 15.41 Ac

VIOLET TRANSECTS
BUTTERFLY TRANSECTS

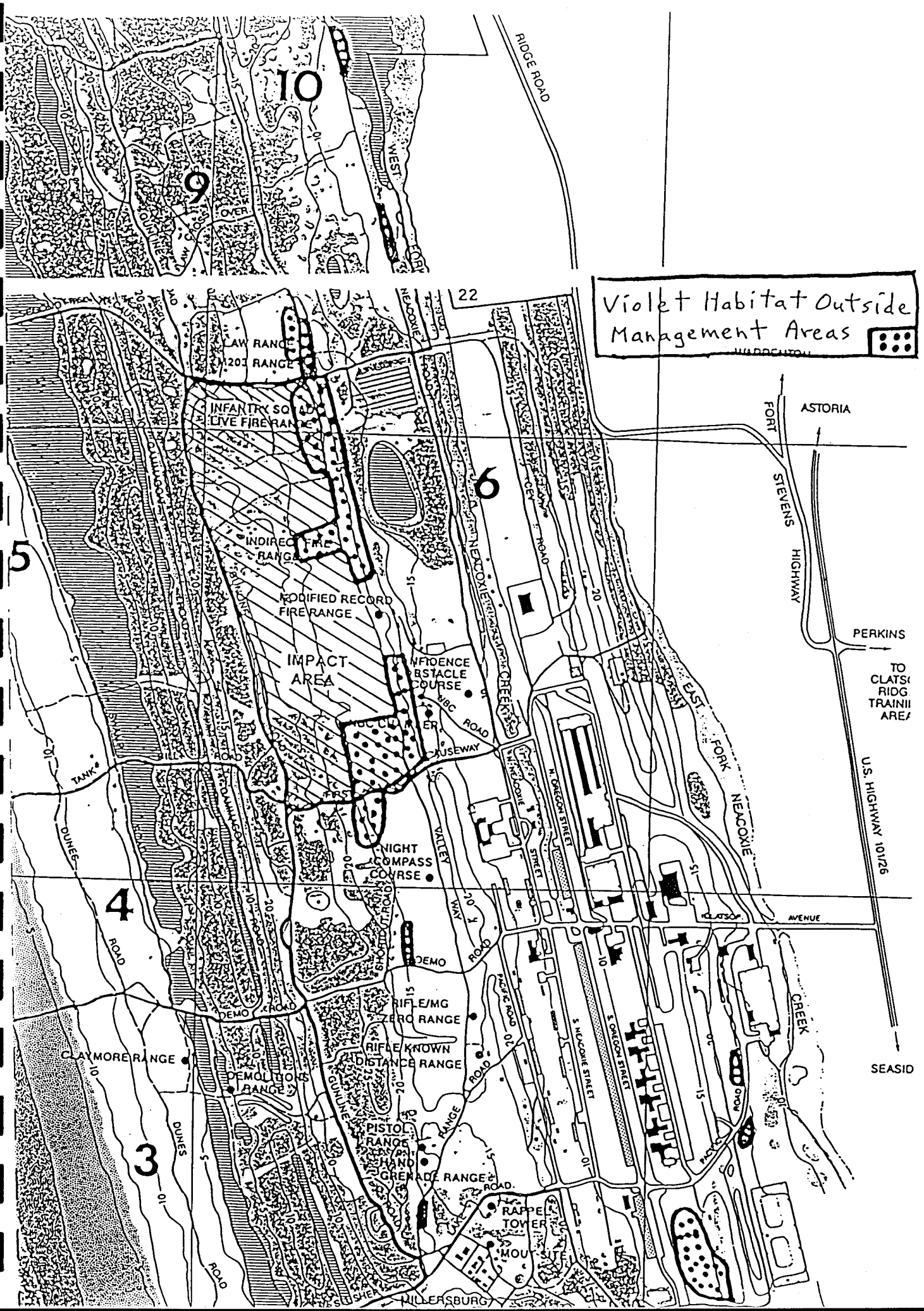
SCALE: 1" = 300'
DATE: 04/17/95
DRAWN: GGL
FILE: SIL_6A

RILEA ARMED FORCES TRAINING CENTER
RT 2, BOX 497-E
WARRENTON, OREGON 97146-9711

TITLE: MAP 6
HABITAT MANAGEMENT AREA 10

APPENDIX 3

VIOLET HABITAT AREAS OUTSIDE OF THE HABITAT MANAGEMENT AREAS


Violet Habitat Outside Management Areas
10
9
6
5
4
3
RIDGE ROAD
22
LAW RANGE
M203 RANGE
INFANTRY SQUAD LIVE FIRE RANGE
INDIRECT FIRE RANGE
MODIFIED RECORD FIRE RANGE
IMPACT AREA
CONFIDENCE OBSTACLE COURSE
NIGHT COMPASS COURSE
RIFLE/MG ZERO RANGE
RIFLE KNOWN DISTANCE RANGE
PISTOL RANGE
HAND GRENADE RANGE
CLAYMORE RANGE
DEMOLITIONS RANGE
RAPPEL TOWER
MOUT SITE
NEACOXIE CREEK
ASTORIA
FORT STEVENS HIGHWAY
PERKINS
U.S. HIGHWAY 101/26
EAST FORK NEACOXIE
N. OREGON STREET
S. OREGON STREET
S. NEACOXIE STREET
CLATSOP AVENUE
PACIFIC ROAD
VALLEY WAY
RANGE ROAD
DUNES ROAD
TANK ROAD
MILLERSBURG